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MALARIA IN MAURITIUS.

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The Colony of Mauritius is a volcanic island 716 square miles in area (nearly equal to Surrey) lying in the South Indian Ocean just inside the tropic of Capricorn and at a distance of nearly 1,400 miles from the east coast of Africa. It lies between latitude 19 deg. 50 min. and 20 deg. 35 min. South, and longitude 57 deg. 18 min. and 57 deg. 48 min. East, of Greenwich.

In general shape, the island, as the late Sir Andrew BALFOUR has aptly written, is not unlike an oyster, the broader end being the southern portion. The general configuration of the land is a belt of low-lying country extending practically all round the periphery and rising more or less gradually to a central plateau of an average height of about twelve hundred feet, though in the middle of the island the land lies higher. The central plateau comprises about a fifth of the total area. There are three main ranges of hills, which account for the peculiarly localized distribution of rainfall which is so striking a feature in the Colony.

Soil and Subsoil.

Mauritius being of volcanic origin, the rocks are igneous and the more superficial consist of lava of varying degree of permeability. In some regions underground caverns exist and the whole subsoil seems to be composed of a material resembling a huge bath sponge containing cavities varying from tiny pores to caverns as large as a dwelling house. This is more or less the case in the northern half of the central part of the island where the soil as a rule is well drained by natural means and, in consequence, absorbs water with avidity. There are, however, other places where the soil and subsoil are much less pervious, where the water table is near the surface and where surface water finds difficulty in being absorbed. On the coastal regions there are many large marshy areas below or just at sea level which cannot be drained.

In many places such as the beds of streams, or outcrops of lava along the coast where the rock is bare, the surface of the rock is pitted with innumerable cavities of varying size which retain water and constitute mosquito breeding-places most difficult to eradicate or to control.

Climate.

The climate generally is that of a sub-tropical island, mild and equable. But there is a remarkable diversity of climate in the island. The eastern seaboard is hot and moderately humid most of the year, in the middle of the island the heat is tempered by altitude, whereas on the western coast the climate is hot and dry. The diversity is due to the configuration of the land and the direction of the prevailing wind. The island lies in the region of the trade winds.

There are two seasons, a cool and a warm, the change from one to the other being fairly abrupt and more noticeable on the central plateau than on the coast. The warm season lasts from November to April, which is also the season of cyclonic storms in this part of the Indian Ocean. Cyclonic storms are accompanied by torrential rains during which a rainfall of eight to ten inches may be recorded in 24 hours, and by high winds blowing in violent gusts, with frequent changes in direction. These storms generally result in a considerable amount of flooding and damage to crops and other property.

Population.

The 1931 Census recorded the total population of the Colony as 393,238 persons. Of this number, 268,649 were of Indian race, 8,923 were Chinese, and the remainder, 115,666, comprised the General Population. The term " General Population " includes all persons in the Colony not classified as Indian or Chinese. In this group are to be found those of pure European descent, the remnant of the original African and Malgache races, and a large group of persons of mixed race.

The distribution of the population is roughly as follows. Most of the Europeans reside on the central plateau. The population of mixed race are to be found mostly in Port Louis, the townships and villages. The Chinese are ubiquitous ; they are retail shopkeepers whose shops are to be found all over the island. The Indians are predominantly agricultural and reside for the most part in the coastal low-lands, in villages and in estate lines. The western part of the island is most sparsely populated, the most densely populated part being the central plateau, if we exclude the town of Port Louis. The mean density of population is about 550 per square mile for the whole Colony.

Language.

Educated persons are at least bilingual, the two main languages being French and English, with this difference, that French is the language spoken in the home, English the acquired language.

Amongst the illiterate the mother tongues are those of their own people, but there has been evolved from the old slave patois, based on the French language and known locally as the Creole dialect, a lingua franca spoken by practically everybody, which is easy to learn, racy in its idiom and of general utility. It is really the language of the people and it has been adopted and evolved to meet the same need for social intercourse as Hindustani and pidgin English do in other parts of the world.

Industries.

The cultivation of the sugar cane and the manufacture of raw sugar are the staple industries of the Colony. This has an important bearing on the distribution of the population. The only town of any size is Port Louis, which has approximately 54,000 inhabitants. The rest of the population, with the exception of those inhabiting Plaines Wilhems district, are distributed throughout the Colony in the agricultural areas. Rum is prepared for local consumption, as a by-product of the sugar industry. Tobacco is grown to some extent, and there is a modest production of aloe fibre for export. In the north and west agriculture requires irrigation. In other regions irrigation is not necessary on account of the more frequent occurrence of rain.

Housing.

The more wealthy inhabitants live in wooden frame buildings, usually raised well off the ground by a masonry plinth. Under-floor ventilation is the rule and such houses are dry and cool. The common roofing material is the wooden shingle. Cement concrete is just coming into vogue as a building material for domestic construction. The houses of the wealthier classes are situated in extensive compounds, tastefully laid out in front in lawns and flower beds. At the back, or to the side of the house, within easy reach, are the servants' quarters. It is the rule for servants and their families to live on the premises of their employers.

The buildings of the middle classes follow the same general lines as those of the wealthier, but on a smaller and more congested scale. Fowls are to be found on most premises.

The labouring classes live in huts of simple design, usually built on a plinth of stones, having walls of wood or, more commonly, ravenal, and a roof thatched with dried cane tops. Most huts have a little verandah. Cooking may be done on the verandah or in some adjacent shack. It is seldom done inside the hut, except in stormy weather.

The housing provided by the sugar estates for their resident labourers is generally more substantial and sanitary than the labouring population can provide for themselves. The general type of estate housing consists of rows of two-roomed dwellings, provided in front with a continuous verandah which the occupiers may or may not partition off at their convenience. The rows are generally set on a masonry foundation, the buildings constructed of wood or galvanized iron on a wooden frame, with a roof of thatch or galvanized iron. Some estates construct stone buildings, which are more permanent and less liable to damage from cyclones. Back-to-back buildings are prohibited and are now rare. The estate managers are held responsible for ensuring that no rank vegetation is allowed to grow within ten feet of the labourers' lines.

Communications.

External.—Steamship communication with Europe, though regular, cannot be described as good. Letter mails to and from Europe take at least a month on the way. Parcels mails require anything from six weeks to two months.

Internal.—The Mauritius Government Railways now maintain regular passenger and goods services over approximately 100 miles of railway. There is also an excellent system of good roads which renders any inhabited part of the island readily accessible. The main roads

are tarred and carry a prosperous motor omnibus and lorry traffic. The bus is greatly used by the poorer classes, who now find places in the island accessible to them which were formerly within the reach only of those fortunate enough to possess private motor transport. The great increase in rapid and cheap road transport is undoubtedly a factor which must be reckoned in studying malaria in the Colony. The rivers are not navigable.

Administration.

The constitution is that of a Crown Colony.

For political and administrative purposes the Colony is divided into the following nine districts whose main features are summarized in the table.

District	Situation	Altitude	Area in sq. miles	Population 1931	Climate
Port Louis ...	North West	Coastal	16·5	54,435	Equable hot humid
Black River ...	West	Coastal	100·0	14,263	Equable hot dry
Pl. Wilhems ...	Central	Above 600 ft.	78·5	95,258	Variable cool humid
Savanne ...	South West	Coastal	94·5	31,101	Equable hot humid
Grand Port ...	South	Coastal	100·5	48,619	Equable hot humid
Flacq	East	Coastal	115·0	52,640	Equable hot humid
Moka ...	Central	Above 600 ft.	89·0	29,283	Variable cool humid
Rivière du Rempart	North East	Coastal	57·0	30,792	Equable hot dry
Pamplemousses	North	Coastal	69·0	36,847	Equable hot dry

In the column " Climate " the terms " equable," " hot " and " cool " are to be read relative to the situation of the Colony. " Equable " denotes that there is little appreciable difference between the day temperatures of the cool and hot seasons. " Variable " means that there is a distinct cool season as compared with the hot. Really hot and oppressive nights are rare anywhere in the Colony.

Plaines Wilhems and Moka are the only districts lying wholly within the central plateau. All the other districts extend to the sea.

The Medical and Health Department.

At the present time the Medical and Health Department is in a transitional stage of organization from the former type to the Health Centre type described by the writer in 1931. Roughly the organization is as follows : To each district there is posted a medical officer known as a Health Officer whose principal duties are the care and treatment of the sick poor and the administration of the sanitary law in his district. He is required to reside in his district and is in charge of the small hospital (of which there is one in each district except Black River), and its satellite dispensaries. It is intended that the dispensaries shall be the nucleus of the Health Centres of the district.

The District Health Officer is in charge of the subordinate medical and sanitary staff and he will ultimately be responsible for the measures

for the preservation of the health of all persons resident in circumscribed areas of his district, in each of which will be established a Health Centre. In the intervening areas the population is comparatively sparse and, as the main diseases affecting the public health are hookworm disease and malaria, these will be dealt with by the Malaria-Hookworm Branch of the Department, about which more will be written in a later part of this article.

In addition to the district hospitals there are three central hospitals, which are equipped for modern operative and electro-medical treatment. There are also a mental hospital and a small hospital for the detention and treatment of lepers. There is a central laboratory which undertakes general pathological diagnostic and bacteriological work, the analysis of food and drugs and medico-legal investigation.

History of Malaria in Mauritius.

Of the three main islands of the Mascarene group, Rodrigues is the only one in which anopheline mosquitoes do not now exist. There is therefore a very strong presumption that the anopheline genus was introduced from either Madagascar or the neighbouring continent of Africa. At the present day there are four anopheline mosquitoes known in the Colony, viz. : *A. costalis, A. maculipalpis, A. mauritianus* and *A. funestus*. So far as is known to date, *A. mauritianus* is not a transmitter of malaria in the Colony ; *A. maculipalpis* was infected frequently by MacGregor (1924), who also found no difficulty in infecting *A. costalis*. Ross and his co-workers also found little difficulty in infecting the last species. MacGregor further established that *A. funestus* could be infected locally quite as easily as *A. costalis*.

So far as malaria itself is concerned, the first indigenous outbreak occurred in the Black River District, in November 1865 at a place called Petite Rivière. From this centre the disease spread along the coast, both northwards and southwards. Port Louis was infected in January 1866, and the most northerly part of the island in December of that year. In 1867 it reappeared in most of the low-lying country where it had previously occurred and appeared for the first time in certain parts of the interior. The disease had encircled all the coastal belt by the end of 1868.

The 1867 epidemic of malaria was a remarkable example of how deadly a disease malaria can be when it attacks a susceptible population deprived of quinine. The Port Louis District suffered the worst. More than 20 per cent. of the total inhabitants died in 1867 from malaria alone. At that time the town of Port Louis had some 87,000 inhabitants and the monthly numbers of deaths were as follows (Fowler) :—

Port Louis : Deaths from Malaria.

1866			1867								
Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
288	309	337	371	1,208	3,812	6,224	4,970	2,059	1,296	620	463

The disease never again regained its former virulence ; the Colony had profited by the lesson and thereafter there was always an adequate supply of quinine available.

This epidemic greatly stimulated the development of the central elevated plateau as a residential area. Before 1857 Port Louis and the neighbouring district of Pamplemousses were the residential parts of

the Colony. The interior was practically uninhabited. After the epidemic many of the wealthier inhabitants settled in Curepipe which, in course of time, became the residential capital of the island, though Port Louis has retained its importance as the seat of government and the commercial capital of the Colony. The advent of plague in 1900 induced many more residents to forsake the town for the interior and now most people who can afford to do so reside in the chain of townships—Curepipe, Quatre Bornes, Rose Hill and Beau Bassin and the villages of Vacoas and Phoenix, which extend in a northern direction from Curepipe in the middle of the island to Port Louis on the north-west coast. They are linked by road and rail, and there is an excellent service of trains and buses between them and the capital.

From its introduction until 1908 malaria was confined largely to that area of country lying below the 600 foot contour. DAVIDSON, in 1892, writes as follows: "At the present day, fever can only be said to be generally endemic below 500 or 600 feet, although in some particular localities it reaches higher elevations than these." But it was gradually ascending, and by 1906 had attained the highest part of the island.

In 1907, Sir Cavendish BOYLE, the then Governor, caused ROSS to visit Mauritius "in order to report on measures for the prevention of malaria there." The War Office at that time maintained a considerable garrison in the Colony and issued orders concurrently to Major C. E. P. FOWLER, R.A.M.C., to accompany Major ROSS for the purpose of assisting him generally, and especially with regard to the measures to be taken for the protection of His Majesty's troops. Each subsequently published a report, ROSS dealing with the civil population, FOWLER with the military. Taken together they constitute a classic on the subject of malaria in Mauritius.

ROSS spent three months in the Colony, from 20th November 1907 to the 28th February 1908. His report was published in that year. He found that Mauritius was one of the first places in the world in which the mosquito transmission theory had been made the basis of anti-malarial operations and that two local entomologists, Messrs. Daruty de GRANDPRÉ and d'Emmerez de CHARMOY had in May 1900 correlated the distribution of malaria in Mauritius with that of *A. costalis*. He also found that, as an anti-mosquito measure, a certain amount of work had been undertaken to clear streams clogged with vegetation and that quinine was distributed free in malarious areas.

As a result of his study ROSS laid down a plan of campaign involving the following procedures:—

(*a*) A periodical spleen census of children in schools and on estates.
(*b*) Treatment of children with enlarged spleens in schools and on estates, and a certain amount of quinine distribution.
(*c*) Occasional house protection.
(*d*) Mosquito-reduction where advisable (*a*) by minor works, (*b*) by major works.
(*e*) A suitable organization and an annual malaria report.

While ROSS was in the Colony the anti-malarial measures which he advocated were carried out with great vigour. But after his departure enthusiasm gradually waned and attention ultimately became focussed upon drainage and canalization as anti-malaria works to the detriment of the other measures which ROSS had advocated. The Government undertook the construction of major works (often in areas where ROSS

himself would have hesitated to advocate them), without due consideration of the dictum laid down by him, "minor works before major works." Ross himself stated that :—

"It would be folly to commit the Colony to a large capital expenditure until the absolute necessity for this becomes quite apparent; and it cannot become apparent unless the minor works and other methods of prevention have been tried for some time, . . . Then, if and where the major works are found to be necessary or economically advisable, they should be carried out. But to rush upon the major works without such preliminary experience would be unwise, except in cases where the necessity for them is already quite obvious."

It need occasion no surprise that the single-handed efforts of the government departments concerned made little appreciable difference to the general malaria situation, though certain localities undoubtedly benefited. The Government became the scapegoat of a population which seldom showed any inclination to reinforce the effect of work done by the Government Departments by undertaking on its own premises the ancillary works which were necessary to render major works effective. Even in recent times the presence of mosquito nuisances upon private premises has deprived the occupiers of the benefit of important major works executed in their neighbourhood. In spite of these difficulties, and of occasional hostile criticism, the Government persisted in its attempts to apply some, if not all, of Ross's recommendations, until in 1921 the unsatisfactory sanitary state of the Colony as a whole led the Government to obtain the services of the late Sir Andrew BALFOUR to advise in what way a sum of at least Rs.10,000,000 might be spent to the best advantage upon sanitary measures.

BALFOUR spent six months in the island and as a result of his visit issued his classical Report on Medical and Sanitary Matters in Mauritius. In this he made an important contribution to the study of malaria in the Colony which has since become the basis of the anti-malaria policy of the Government, on which the new campaign has been founded. His significant observation is recorded as follows : "Without entering into details I may say that I was greatly struck by the way in which, during the winter, the breeding area of *Anopheles costalis* became restricted." Lack of time prevented him from following up this observation but he was instrumental in obtaining the services of the late M. E. MACGREGOR, an expert field entomologist, who worked in the Colony from June 1922 to June 1923. MACGREGOR thus spent a full year in Mauritius and was able to confirm and give more precision to Sir A. BALFOUR'S observation regarding the restriction of Anopheline breeding-places during the cool season. He also discovered that *A. funestus*, a notorious malaria transmitter, was present in the Colony and that it had a widespread distribution.

MACGREGOR'S observation on the seasonal restriction of anopheline breeding was recorded as follows :—

"*Anopheles costalis* in Mauritius, in the regions above (*i.e.*, 600 feet) the coastal belt, survives the winter not by hibernation but by the adoption of sheltered 'winter refuges,' where, restricted to the immediate vicinity of these winter refuges, it pursues the regular course of its life until, with the onset of warmer weather and the coinciding wet season, it is enabled to spread speedily further inland to the limits of its summer distribution. Conversely, with the onset of the colder weather in the following autumn and the drying up of many of the breeding places in the ensuing dry season,

those individuals who happen to be outside the sites of the sheltered winter refuges are exterminated."

He also recorded the absence of *A. funestus* at altitudes above 500 feet.

MACGREGOR was an entomologist and it is only natural that his recommendations should have a strong entomological bias. He omitted any reference whatever in his report (1924) to patients or plasmodia, either because he considered that the existing provision for the medical care of the population was adequate to deal with that side of the problem, or because he deliberately omitted these considerations as being unimportant. His recommendation was, briefly, that a special Anti-Malarial Department be organized, staffed principally by entomologists of various grades and provided with engineering, financial and clerical branches. The scheme of campaign was to deal firstly with what he described as the inland winter refuges which were to be found all over the central inland area between the altitudes of 600 and 1,200 feet. He estimated that one cool season would suffice for this work, as he considered that these refuges were neither very numerous nor difficult of eradication. Thereafter, the abolition of anopheline breeding-places in coastal areas was to be undertaken in a series of triangular areas, their apices lying in the middle of the island, their bases formed by the coast line. He stipulated that only proved anopheline breeding places were to be dealt with, other mosquito nuisances being left alone.

This plan of campaign looked very impressive on paper, but, apart from a number of administrative features which were quite impracticable, it appeared to me to be based on the ingenious assumption that neither of the principal anopheles with which it was concerned had any power of adaptability. It also implied that the year during which the survey was made might be regarded as an average year regarding rainfall and other climatic factors. These were very big assumptions and they were not supported by anything which was known of the factors concerned. On the contrary, the wide geographic range of both *A. costalis* and *A. funestus* showed that those species must possess a very high degree of adaptability, and to assume that the members of those species occurring in Mauritius should have lost such an important biological asset was relying too much upon appearances and disregarding a considerable accumulation of knowledge. There was no evidence that if one breeding-place was abolished the species could not adapt itself to another. The assumption regarding the climate was also unsupported by experience. The only consistent feature about the Mauritius climate is its inconsistency. There is no such thing as an average year, and so far as malaria is concerned, the advent of a cyclone of moderate severity may change anopheline distribution in the Colony in a few weeks. The cost of the abolition of anopheline breeding-places in the coastal belt was far beyond the possibilities of the colonial budget even at that time.

These objections, though not actually recorded at the time, undoubtedly prevented the immediate inception of the campaign associated with MACGREGOR'S name. However, in the beginning of January 1927, it was decided to institute a systematic campaign based on MACGREGOR'S recommendations. The anti-malarial work of the Medical and Health Department then fell into two categories.

(*a*) The maintenance of works that had been carried out in accordance with Ross's recommendations.

(*b*) The prosecution of the first part of the MACGREGOR campaign. For this, a new staff was organized, largely consisting of men who had

worked in association with MacGregor when he made his survey. The first stage of the new campaign was to be devoted to propaganda in the area of the proposed operations and a re-survey of the inland winter refuges. Major works begun under the Ross plan were to be completed but no new major works were to be undertaken until the winter refuges had been surveyed, and an estimate made of the cost of their eradication.

These good intentions were shattered by a malaria scare at Curepipe which, hitherto, had been regarded as being malaria-free for all practical purposes. As this town is regarded as the sanatorium of the island the occurrence of locally contracted malaria in it led to an immediate outcry for the expenditure of Government money, though a number of cases had been contracted in association with breeding-places occurring on private premises. One family were infected by mosquitoes which had apparently hatched in the domestic fowl-run, careful search having failed to discover any other breeding-place in the vicinity. The scare, however, provided an excellent opportunity for a comparison between the cost of a work recommended by Ross and estimated by him at Rs.18,000 and its actual cost, which in 1930 was nearly Rs.72,000. MacGregor, wisely perhaps, made no estimates of cost.

While this was going on the " Inland Winter Refuges " were surveyed. In 1927 their numbers had increased from the 10 recorded by MacGregor to 61. The estimated cost of their eradication was Rs. 432,000, and this in the least malarious part of the Colony! From 1928 to 1931, the same survey work was carried on and the " refuges " mounted steadily in numbers until by 1931 they numbered 128, of which 65 could be reckoned as recurrent nuisances, the others being merely seasonal and unlikely to recur during the next cool season. Moreover, indigenous malaria was now occurring in places from which it had formerly been absent.

During this period the financial state of the Colony had greatly deteriorated so that the Government was faced with the urgent need of curtailing expenditure in every department in order to obtain a balanced budget. The activities of the Medical and Health Department could not escape the pruning knife and drastic measures were taken to curtail expenditure.

The only virtue of an economic slump is that it shakes one out of comfortable, unprofitable routine and brings one face to face with essentials. And there is no subject in tropical hygiene in which the importance of a firm grasp of essentials is so vital as in malaria. As I have written elsewhere (1931), routine measures, based on general epidemiological principles, will always take us a certain distance on the path of sanitary salvation, but there comes a time when routine methods will carry us no further. They then need to be supplemented by methods devised to meet the circumstances of the case before us ; of the area in which we desire to progress. This is just as true of Mauritius as it is of other parts of the tropical world ; perhaps, on account of the remarkable diversity of climatic and physiographical conditions encountered locally, even more so than of most places. A survey of what was known locally about malaria was therefore undertaken and from the data so collected the broad lines of policy were formulated.

The situation at this time was that a number of major works executed under the Ross scheme in various parts of the Colony were

being " maintained " by the employment of gangs of men to restore the canalization of watercourses damaged by cyclonic storms, to keep streams free of weeds which might impede the flow of the water, and to keep channels which had been cut through rock free from the rubble carried into them by floods. Owing to the nature of these works, to the fact that many of them had deteriorated to such an extent as to have completely lost their effectiveness, and to the continual exposure of the Colony to cyclonic storms and their attendant destruction of most surface drainage works, maintenance was a very heavy charge on the colonial budget, while the value of the works themselves was by no means commensurate with the expenditure, either because of deterioration or because extensive minor nuisances on private property, or in the neighbourhood of the works themselves, completely nullified whatever beneficial effect they may originally have exerted. A survey of all these works was therefore made and their value carefully assessed, so far as one could ; those which were considered to be now valueless were abandoned, the maintenance of those selected for preservation was reorganized and put upon a more efficient footing. Since most of these works were in the coastal area this policy harmonized with the general policy laid down.

Malaria at the Present Day.

In formulating the general policy consideration was given to the increase in our knowledge of the disease which has taken place in recent years and has been ably summarized in two publications of the League of Nations (1927, 1933). The local information was scrutinized in the light of this knowledge and the following broad principles formulated.

Malaria in the Colony can be regarded as occurring in three regions, in each of which conditions are fairly uniform and characteristic. Those regions are (1) the town of Port Louis and its environs, (2) the coastal lowlands, and (3) the central elevated plateau.

(1) *Port Louis.*—The town of Port Louis lies on the floor of a bowl-like formation of country, half the circumference of which has disappeared into the sea ; the remaining rim of the bowl forms a magnificent and picturesque amphitheatre of rugged hills with precipitous sides intersected by two main cuttings, the Vallee Pitot, and the Tranquebar. The bottom of this formation is now roughly elliptical in shape, the long axis being some three or four miles in length, while the short is about a mile and a-half. The long axis runs more or less parallel with the coast. This area is fairly flat, having a gentle rise from the coast to the foot of the surrounding hills. The soil is largely composed of rubble, gravel and boulders, with a few marshy areas here and there. Numerous springs find their outlet in this area, which is intersected by several streams finding their way from the hills to the sea.

The town itself is the only seaport of the Colony. It is roughly kidney-shaped, its long axis coincident with the long axis of the site and the most congested portion is the half nearest the harbour. As the town proceeds inland congestion gives place to spaciousness, until one reaches the inland municipal boundary at which one is in that peculiarly drab no-man's-land which is so characteristic a feature of many tropical towns where the occupied parts give place to open country. The town was planned by LABOURDONNAIS on the rectangular system and it has been well laid out. Before the great malaria epidemic it was a bustling place, harbouring an energetic and vigorous community

and in frequent touch with the outer world. The cumulative effects of the advent of the steamship and the opening of the Suez Canal have deprived it of its strategical importance both from a military and a commercial point of view, while the exodus of the wealthier classes of population to the interior following upon the malaria epidemic, the hurricane of 1892 and, later, the plague, have lowered its rateable value to a very great extent. It is now only inhabited by the poorer classes and by one or two professional men whose work entails residence there.

In 1931 the census population of the town itself, as apart from the district which bears its name, was a little over 47,000 persons, males and females in almost equal proportion. Of these, 20,251 were of Indian race ; 4,142 were Chinese ; and the remainder, 22,669, were classed as the " General Population." The general economic level of this population is low, its hygienic practice rudimentary and its death-rate commensurately high.

The town is governed by an elected Municipality, which, however, in 1921, had its powers drastically curtailed when important municipal services such as the maintenance of roads, sanitary services and water supply were taken over by the Government and entrusted to the Public Works and the Medical and Health Departments.

The town presents two important and striking features in relation to malaria, one due to human agency, the other arising out of its situation. It is difficult to appraise the effect of each of these on the malarial situation. The first factor mentioned is the municipal water supply. This is designed to supply the population with some 5,000,000 gallons of water a day, an average daily consumption of over 100 gallons per head. There are no large water-consuming industries in the capital and this phenomenal figure represents the domestic consumption of the town. It is clear that three-quarters of this water must run to waste ; and this is so. Wastage occurs frequently from leaky pipes ; and largely from the entire lack of water discipline in the population who have never, by means of meters, been obliged to pay for what they waste. The result is that in the more sparsely occupied areas of the town there continually recur water nuisances which are extremely difficult to control with a limited staff.

The other important malarial feature is inherent in the site. The semicircular range of hills flanking Port Louis on its southern aspect constitutes a catchment area whose only outlet is through the town itself. In dry weather the valleys on the inland side of the town are scarred with numerous stream beds in which there is no water to be seen ; or whose course may be marked by a succession of pools. Where those streams traverse the municipal area on their way to the sea they have been canalized and in part confined in fine old masonry channels which have served their purpose well. During the greater part of the year there is little water running through them. But a heavy and prolonged shower of rain changes all this. The dry stream beds become torrents tearing their way down the hill sides, excavating new courses and carrying with them trees, branches, boulders and rubble in large quantities. The force of such torrents is sufficient to tear up whole sections of canalization even within the municipal limits and to obstruct the outlets of the streams with tons of gravel, boulders and other miscellaneous rubbish, causing flooding in the town itself and further up the stream. During the cyclone season such floods are always likely to happen, and a number of them in succession throughout the warm season means the creation of a vast area suited to the

breeding of *A. costalis*, the common malaria vector. It is little wonder that the resources of the Colony have been unable to cope with the Sisyphean task of " training " these streams and watercourses.

The dangerous anopheline nuisances resulting from floods arise at or just within the municipal limits rather than outside them or in the congested parts of the town itself, and it is clear that the natural, as contrasted with the artificial, municipal anopheline nuisances cannot be economically controlled in the absence of means to control the flood waters. Attempts have been made in the past, by the construction of large circumvallatory drains on the hill sides, to control floods, and to divert part of the water, at any rate from the middle of the town itself. Successive floods, and the peculiarly friable nature of the soil, have so damaged these drains as to render them more of a liability than an asset. The only solution to the problem of malaria in Port Louis appears to be to regulate, by means of dams, the flood water coming down the valleys, converting the lower part of each valley into a small lake which will act as a buffer between the flood and the town and which will, by appropriate sluice gates, enable the water to be ultimately discharged in a controlled stream over a period of weeks or months. When this has been accomplished, the reconstruction of the intra-urban drains can be undertaken with some prospect of permanency, and their subsequent maintenance effected at an insignificant cost. But the cost of those major engineering works will be high, a fact which, at present at any rate, rules them completely out of consideration.

What is the next best thing ?

When effective action on the anopheline is impracticable an attempt may be made on the plasmodium. Fortunately, Port Louis is well placed with regard to means for the treatment of the disease. A number of medical practitioners reside in the town and their numbers are augmented by several who maintain consulting rooms there, though non-resident. There are many druggists' shops. There is the Civil Hospital with an out-patient department at which free consultations are given daily, and there are two Government Dispensaries for the same purpose. The Government Poor Law Department also maintains a part-time medical officer for the examination of persons applying for relief on grounds of ill health or bodily infirmity.

In addition to these professional agencies there are always to be found a sufficient number of public-spirited citizens who are prepared to keep on their premises a stock of totaquina tablets which are distributed gratis to those suffering from fever. This organization was inaugurated by the Mayor during a sharp outbreak of malaria in 1930 and successive mayors have continued the arrangements in each subsequent malaria season.

The town cleansing branch of the Health Department under the Government Medical Officer of Health for Port Louis has hitherto endeavoured to keep free of obstruction all the masonry drains passing through the town. Financial stringency has greatly handicapped the work but the drains have been kept clear for the most part, though they are frequently obstructed for a longer period than is desirable. The oiling of certain notorious pools and the filling of others situated on the outskirts of the town go on throughout the year.

It is clear, however, that such palliative measures cannot effect any cumulative improvement. The only radical measure in the catalogue is the treatment of patients. But this, on account of the impossibility of persuading patients to take an adequate course of treatment, takes

merely a palliative form. Real improvement will come only after the regulation of the flood water, and the imposition of water discipline with regard to the domestic water supply, and the prospects of the adoption of either measure are remote. The present policy is, perforce, to work along palliative lines meanwhile, in the hope that at some future date the resources of the Colony will enable radical measures to be instituted.

(2) *Coastal Lowlands.*—Conditions in the coastal belt are fairly uniform. The climate is favourable to mosquito breeding throughout the year and the numbers of mosquitoes vary largely with the rainfall, or rather with the monthly number of rainy days. A succession of rainy days totalling perhaps only a couple of inches of rainfall will create a much greater mosquito nuisance than a single heavy downpour of twice that amount. The population is scattered, though mainly distributed along the roads or resident on sugar estates; there are numerous tidal lagoons and marshes. A number of marshes are at or below sea level. Villages are few and not usually compact, the houses generally straggling along the road for some distance, there being little actual depth to the village itself.

In such regions the control of mosquito breeding throughout the area is quite impracticable with the means at our disposal. We can only hope to institute mosquito control in the close neighbourhood of places inhabited by such a number of persons as will bring the *per capita* cost of the measures within reasonable proportions. In the writer's opinion the policy one must adopt is to control malaria, not mosquitoes, and this may best be done by making totaquina, quinine and the accessory drugs available to every sufferer from the disease. Arrangements are made with rural shopkeepers to sell totaquina in tablet form at cost price.

Bonification cannot be carried out by bringing new areas of land under cultivation. Most of the available land is already producing its maximum quantity of the staple crop. Other crops have been tried from time to time but they have failed even to threaten the supremacy of the sugar cane, which is the only cyclone-resistant crop known to be suitable for local cultivation. Further, in the present state of the international sugar market, where most of this foodstuff is being sold below the cost of production, and when sugar-producing colonies are subsisting on what is practically an Imperial dole, bonification by means of increased remuneration of the labouring classes is quite impossible.

(3) *Central Plateau.*—In the central plateau we have an area admirably suited to mosquito control. Our great ally is the cool dry season which, even now, has a remarkably restrictive effect upon the distribution and numbers of anophelines. The density of population is high, and this factor, compared with the estimated cost of the construction and maintenance of major works brings the *per capita* cost of the measures well within the range of practical politics. It may be too much to hope for the eradication of anophelines from this area, but surveys have shown the practicability of bringing them under control.

Combined with these favourable circumstances we have a large resident population of European descent, and a large proportion of the total population in reasonably affluent circumstances and able financially to co-operate with the Government in mosquito control. The area is well provided with resident doctors in addition to having two Government hospitals and a number of Government dispensaries, so that, though no direct attack on the plasmodium is planned, the means

available for the treatment of patients encourage the belief that treatment plays a substantial part in this area. Government policy is accordingly directed towards mosquito control, and by this is meant, principally, anopheline control throughout the area which comprises practically the two districts Plaines Wilhems and Moka.

Malaria Organization.

The Medical and Health Department of the Government is at present in the transition stage between its former organization and that recommended for future adoption. In the future, however, anti-malaria work will be entrusted to a special branch of the Health Department, staffed by three medical officers, an entomologist, clerk, and the requisite number of subordinate workers. This branch will be responsible for the continuous study of malaria in the Colony in all its aspects, and it will initiate, construct and maintain all anti-malarial major works for which the Government is responsible in the central plateau, and in such parts of the rural districts as do not fall within the areas of the Health Centres. Health Centre areas will be in charge of the district health officers, who are responsible for all medical and sanitary matters within the Health Centre areas, which will be so delimited as to include all important collections of dwellings in the districts.

Financial stringency has led to the malaria staff, or at least the professional members of it, being also entrusted with the hookworm campaign, but, as the hookworm work is carried out in the early morning, the two campaigns are not so incompatible as would appear at first sight, and, so far, the combination has worked well. There is no reason why it should not continue to do so.

The nucleus of this branch, a medical officer, entomologist, secretary, microscopist, and about 140 regularly employed subordinates and a variable number of labourers, has already operated since 1927. Much valuable survey work has been done, and a number of important drainage works executed by the sanitary engineer working in close co-operation with the branch. Its activities have been practically confined to the so-called MacGregor zone in which the fully staffed branch will carry out most of its executive work for some years to come.

The plan of campaign laid down has been to select two points in the zone (one at the town of Curepipe ; the other at some little distance to the west of the township of Quatre Bornes) ; to survey a roughly circular area of about half a mile radius round each ; to eliminate all serious permanent anopheline breeding-places in these areas, and to keep under surveillance and control all collections of water likely to become temporary breeding-places. When the area of half mile radius has been thoroughly dealt with, the radius is extended by again half a mile, and so on until eventually the contiguous circumferences fuse and the whole area has been treated. The completion of this work will be sufficient to keep the branch fully occupied for a number of years, and in this connexion it should be noted that previous estimates of the duration of malarial campaigns in the Colony have greatly underestimated the time factor. Even were funds available, which at present they are not, there would not be sufficient labour to enable the works to be carried out in one or two cool seasons. In spite of its densely populated state the Colony experiences, paradoxically enough, labour shortage at harvest time when every available labourer is required for the crop. No Government could at that time justify the diversion of labour from the estates, even for sanitary works of some importance,

to the extent apparently envisaged or possibly overlooked by previous writers on this subject.

The staff of the Malaria-Hookworm Branch will be vested with the powers of the Sanitary Authority to enable them to ensure compliance of the sanitary law and regulations so far as these are applicable to their work.

Legislation.

The main legislation dealing with malaria is contained in the Public Health Ordinance 1925. Part VII of this Ordinance enacts that occupiers or, in their absence, owners shall keep their premises free of articles capable of holding water liable to breed mosquitoes ; in the same section it is enacted that wells, watering basins, tanks, and other vessels meant for the storage of water on premises, shall be effectually screened. After the responsible party has been once warned, the subsequent presence of mosquito larvae on the premises constitutes an offence in respect to each collection of water and renders him liable to a fine not exceeding Rs.100. Provision is also made whereby the Sanitary Authority may take immediate steps for the destruction of larvae so found.

In the section of the Ordinance entitled " Miscellaneous," power is given to the Governor in Executive Council to direct the execution of works anywhere in the Colony for the purpose of effecting sanitary improvements. Amongst the measures which may be so executed are the drainage of marshes or other low-lying grounds where water may accumulate and such modifications of stream beds as will abate the nuisances so caused. Works of this kind required on Crown lands are to be executed by the Government, and on private lands by the Government or the owners. Provision is made for the assessment of the cost of such works and the proportionate chargeability of the beneficiaries. The cost of maintenance of the works is also apportioned among the beneficiaries, according to the provisions of the Ordinance.

An old Ordinance, 13 of 1875, originally intended to make better provision for the conservation of the woods and forests of the Colony and to protect the watercourses, has since been found to be a useful instrument for the prevention of the breeding of *A. costalis* in rivers and streams. In its modern form it enacts that there shall be a strip of wooded land bordering upon all rivers and streams and that trees growing thereon shall not be cut without the permission of a Board known as the River Reserves Board, in whose jurisdiction all such matters fall. The strip of wooded land varies in depth according to the class of watercourse it borders ; the depth of the strip being 50 feet on either edge of a river, 25 feet for a rivulet and 10 feet for a feeder. Those strips of land are known as River Reserves. The history of the River Reserves shows that they have been assailed more than once on sanitary grounds, but the discovery that *A. costalis* larvae were exceedingly rare in streams whose waters were shaded by the trees growing in the Reserves and that destruction of the Reserves was followed by the appearance of these larvae in the corresponding part of the stream, established them firmly as assets in the sanitary balance sheet of the Colony. The Reserves were entrusted to the Board mentioned above consisting of the Medical Director, the Conservator of Forests, and, recently, the Inspector General of Police, and it is now the policy of the Board to maintain these reserves fully planted up.

One would think that the anti-mosquito provisions of the Public Health Ordinance would give the Medical and Health Department

enough power to cause the abolition of all minor nuisances on private premises. That minor nuisances in large numbers still exist is scarcely the fault of the Legislature or of the Health Department. The success of any legislative measure depends upon a number of factors, among which we may include approximately in the order of their importance, its practicability, the civic sense of the population, and the general habits of the people. Other conditions are the general economic state of the population as a whole and the means at the disposal of the Government for ensuring the enforcement of the law. In practically every one of these essential factors we find a lamentable deficiency of the elements which ensure an effective anti-malarial campaign. It is impossible in a communication of this kind, which must necessarily be brief in relation to the subject, to analyse the various factors concerned. But it is apparent that a legislative measure can succeed only when it commands the active co-operation of the majority of the people and this particular section of the Public Health Ordinance has hitherto failed to do so. Nevertheless, active steps are being taken to bring within its provisions the elevated plateau, where the majority of the minor anopheline nuisances occur, and are allowed to persist, on private premises. Freedom from malaria in this region of the Colony depends entirely upon the cumulative effect of the action taken by each person to keep his premises mosquito-free ; by no means an impossible or arduous task, and the efforts of the Anti-Malaria Branch of the Department will be directed towards hammering this important fact home in all concerned.

Vital Statistics.

The reader will have doubtless remarked by this time the absence of any detailed reference to statistics relating to malaria in the Colony. The means at our disposal for the collection of accurate statistics are quite inadequate, and the absence of accurate statistical data is a serious handicap to the work. Taking the records in general, it may be said that the actual death rates and birth rates are accurate. Where inaccuracy creeps in is in statements of the causes of death. The main statistical grouping of the causes of death gives a fairly accurate picture of the proportionate incidence of groups in the death returns, but when one proceeds beyond the group one ventures into the realm of surmise. Some twelve years' experience of the Colony leads me to believe that malaria is recorded as a cause of death much more frequently than is actually the case, and that the numbers of patients attending the dispensaries on account of malaria are exaggerated. There is a tendency to regard each new patient suffering from a febrile illness as a case of malaria. The early cases of an outbreak of influenza in a locality have been recorded as malaria, and there is no doubt that the returns are exaggerated in this way. The general tendency is to overstate malaria and understate the diseases in which the early symptoms may be confused with it.

In the absence of accurate statistics regarding the disease itself the only index of endemicity left is the splenic index and it is this which will be adopted as the standard, though special enquiries regarding malarial morbidity and the incidence of deaths from malaria on age and sex groups will be made in selected areas.

Plasmodia.—The common cause of malaria in the Colony is *P. vivax*, *P. falciparum* is also fairly common, but *P. malariae* is rare and is confined to certain localities. A. R. D. Adams has recently discovered *P. tenue* but it is extremely rare.

Outlook.

The prospects of the control of malaria in the Colony differ according to the three regions already described. The prospect of effective control generally throughout the coastal region is very remote ; and it appears that the disease will remain endemic there for many years to come. In Port Louis the control of flood water and the regulation of the use of domestic water would go a long way to reduce the disease to insignificant proportions. But this will largely depend upon the possibility of constructing the necessary major works, which depend entirely upon the financial prospects of the Colony. On the central plateau the control of malaria is possible, but only with the effective co-operation of the public. This is so true that the quantity of malaria in this region can be regarded as a fairly good index of the sanitary practice and intelligence of the inhabitants. If they are determined to control the disease, the power is theirs and theirs alone. It is by no means an impossible task. And in this area Ross's dictum " minor works before major works " requires constantly to be kept in mind. Unless the dictum is adopted as the policy of the Government, there is always the danger that occasion will be given for the old complaint that in spite of the vast sums spent by the Government to date on major works the morbidity from malaria in this region is practically unaffected.

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LEPROSY.

INTERNATIONAL JOURNAL OF LEPROSY. Manila. 1933. Apr. Vol. 1. No. 2. pp. 129–264; July. No. 3. pp. 265–392; Oct. No. 4. pp. 393–512.

The following information on the distribution and epidemiology of leprosy in various countries is reported in Vol. 1, nos. 2, 3 and 4 of the *International Journal of Leprosy*.

i. **Leprosy in Finland** [CEDERCREUTZ (Axel)]. pp. 195–199. With 4 figs.

i. In Finland careful censuses show an increase in the lepers from 52 in 1893 to 95 in 1904, but a subsequent decrease to 34 in 1931, 16 of whom are in a leprosarium. The average age has increased from 45 to 59·4 years and the nodular cases have decreased from 68·7 to 27·4, so the disease is tending to die out, but in the seven years since 1924, 11 nodular and 11 nerve cases have been found, nearly all in the south-west. Voluntary isolation is advised.

ii. **Leprosy in Estonia and Latvia** [PALDROCK (A.)]. pp. 201–204 With 1 map.

ii. In Estonia a questionary revealed 242, or 0·21 per mille, lepers in Estonia, of whom 195 are in institutions and 47 under control in their homes under a compulsory isolation law. Some cases have been released as "cured" after two years negative bacteriological tests.

In Latvia 207 cases, about 0·11 per mille, are known; and 174 are isolated in an institution and 33 in their own homes. Complete "cures" have been obtained with X-ray treatment. No information could be obtained from Lithuania.

iii. **Statistics of Leprosy in the Krutyje Rutschji Leprosarium, Leningrad** [STEIN (A. A.) & KARPICHINA (Anna)]. pp. 309–320.

iii. This paper records an analysis of 637 lepers in one of the oldest Russian leprosaria founded in 1894 at Krutyje, Leningrad. Of these 60 per cent. were males; 57 per cent. were nodular, 21·4 per cent. nerve and 21·6 per cent. mixed cases, with a tendency to an increase in the proportion of nerve cases indicating a decline in severity. Only 35·4 per cent. were from 0 to 20 years of age, and 53·3 per cent. admitted contact with lepers, mostly relations. The primary lesion was recorded in 88·3 per cent., and the duration before admission was 12 to 15 years owing to early cases being hidden.

iv. **Leprosy in St. Croix. A Study of the Inmates of the Leper Asylum** [FOX (Howard)]. pp. 321–328. With 3 figs. on 1 plate.

iv. This is a report of a visit by Dr. H. Fox of New York to the small island of St. Croix in the West Indies Virgin Islands group, where 106 lepers had been found by EHLERS in 1902; now 82 are in an asylum, mostly females, with an average duration of the disease of 14·6 years and a preponderance of nerve cases.

v. **Summary of the First Leprosy Census in the Republic of Mexico** [URUEÑA (Jesus Gonzalez)]. pp. 329–336. With 1 fig.

v. In Mexico a questionary elicited answers from only about half the doctors, and from only 19 per cent. of the townships, so the total of

1,450 lepers reported must be much below the true number. The age of onset: persons up to 19 comprised 22 per cent. of the cases, most were in males, 59 per cent. were nodular, and over half admitted possible contagion. Some of the principal centres were hot coastal areas.

vi. **The Incidence and Treatment of Leprosy in British Guiana and the British West Indies** [Rose (F. G.)]. pp. 337–340.

vi. The incidence of leprosy in British Guiana and the West Indies is dealt with by F. G. Rose, whose work in organizing the modern methods of prophylaxis and the treatment of early cases at clinics in British Guiana has been recorded in previous issues of this *Bulletin*. Taking only cases in institutions so as to be comparable, he finds that the official records show an average incidence in the more affected larger West Indian Islands of 0.5 per mille, but varying from 2·3 per mille in the small island of St. Kitts down to only 0·1 per mille in Jamaica, where there are very few children in the asylum and the numbers known are evidently far below the real total. The same is doubtless true to a less extent of all the areas outside British Guiana in the absence of facilities and legal sanction for early cases to be treated at clinics without isolation.

vii. **Notes on the Work of the United States National Leper Home** [Denney (O. E.)]. pp. 399–406.

vii. This paper is an abstract of the annual report of the U.S.A. Carville National Leper home with a capacity for 356 patients, which was fully occupied. The admission of 80 patients, 61 of them new ones, was the highest known, and as usual the majority came from the Gulf States. The deaths were 20, or 56 per mille. Chaulmoogra esters are being less used, but Fowler's arsenical solution orally has become more popular and is considered beneficial. The special skin, neuro-psychiatric, orthopaedic, dental, laboratory and X-ray services under specialists have been maintained, and diminishing discontent among the patients is reported.

viii. La lèpre en Afrique Occidentale Française. Etude bibliographique [Robineau (M.)]. [**Leprosy in French West Africa.**] pp. 459–462. [10 refs.]

viii. The incidence of leprosy in French West Africa is dealt with by M. Robineau in a summary of the recorded data, which shows a very extensive prevalence which is serious in some areas. Thus in Ivory coast villages the rates vary from 36 to 211 per mille, on the Upper Niger the rate is 33 per mille with a total of several thousand cases both there and in Dahomey. A prophylactic leprosy service has recently been organized for these French territories.

ix. **Leprosy in Canada** [Heagerty (J. J.)]. pp. 463–468.

ix. Leprosy in Canada is dealt with by J. J. Heagerty, who recalls the first discovery of the disease in 1815 and the opening of the Tracadie leprosarium in 1844 for Western Canada, which has since cared for some 150 cases; it was rebuilt and modernized in 1896, and now has 9 cases, 4 of which are arrested. In British Columbia there is an island lazaretto for imported cases with 5 Chinese male lepers in 1932. As no new cases have appeared in New Brunswick since 1919 the disease appears to be dying out there. *L. Rogers.*

LEPROSY REVIEW. 1934. Apr. Vol. 5. No. 2. pp. 51–98. With 9 figs. on 2 plates. Quarterly Publication of the British Empire Leprosy Relief Association, 29 Dorset Square, London, N.W.1.

This number contains the concluding portion and the recommendations in Dr. R. G. COCHRANE'S report on leprosy in Ceylon. He advises modification of the Leprosy Ordinances to make segregation less rigid, further surveys, propaganda and the treatment of early active cases with isolation of infective cases on the lines of recent work in India. The present compulsory powers should be retained for the present to enable refractory infective cases to be dealt with.

Surgical problems are dealt with by A. ROY, who advocates more free removal of dead bone to allow trophic ulcers to heal, amputation in some crippled cases, and operative measures to give lasting relief in cases of ectropion.

Antimony treatment is once more advocated by F. G. CAWSTON, although he does not report any further personal experience of it, but mentions that it was given up after full trial in the Zululand leprosarium.

The first part of a short history of the foundation a decade ago of the British Empire Leprosy Relief Association is recorded by L. ROGERS. *L. R.*

LEPROSY IN INDIA. 1934. Jan. & Apr. Vol. 6. Nos. 1 & 2. pp. 1–68; 69–126. With 1 fig. & 1 chart. Issued quarterly by the Indian Council of the British Empire Leprosy Relief Association.

The following are the more important articles in the January issue.

G. RYRIE writes on the incidence of leprosy among the S. Indian and Chinese races in the Malay States, and notes that the former suffer more from the milder nerve types and the latter from the more severe dermal forms, in spite of the Indians living on a less nourishing diet. GLASS and RISHI have examined the bone marrow, either post-mortem or in excised necrosed bone, in 69 cases and found lepra bacilli in 17 out of 21 mixed cases but in none of 48 nerve cases.

E. MUIR and S. P. CHATTERJI report favourable results in leprous eye lesions with trypan blue injections in the form of 0·1 per cent. solution in normal saline injected subconjunctivally, or in a 1 per cent. solution intravenously once or twice a week in doses of from 3 up to 20 cc., freshly prepared solutions of Grubler's preparation being advised. Brief notes of 11 cases show uniform partial or complete relief of pain and improvement of vision.

E. MUIR discusses factors influencing the nature of leprous lesions, and Mrs. TODD records the remarkable success of a Leper day in raising over £2,500 in the Salem district of Madras. Further papers read at the Calcutta March 1933 Conference are printed, but contain nothing new.

In the April number E. MUIR suggests additions to descriptive nomenclature adopted by the Leonard Wood Memorial Leprosy Conference to enable estimates to be made of the degree of resistance of the patient, the skin area affected, the bacillary concentration, etc., nearly all requiring laboratory tests and so applicable to research institutes in enabling the effects of treatment to be more accurately gauged. J. LOWE has obtained little effect on preparations of *M. leprae muris* in vitro by chaulmoogra and hydnocarpus preparations

on the lines of WALKER and SWEENEY'S work on acid-fast organisms, but he points out that such observations do not prove that it has no effect in vivo. *L. R.*

SIMONS (L. H.). De lepra op het eiland Ambon. (Een bijdrage tot de kennis omtrent het besmettelijkheidsvraagstuk der lepra.) [**Leprosy on the Island of Ambon. The Question of its Infectivity.**] —*Meded. Dienst d. Volksgezondheid in Nederl.-Indië.* 1933. Vol. 22. No. 4. pp. 197–208. With 2 maps on 1 folding plate.

The island of Ambon (Molucca group) is peculiarly suitable for the study of leprosy owing to its common occurrence there. It is the author's contention that the closeness of contact which exists among the inhabitants with, in many cases, a remarkable freedom from leprosy is not favourable to the view of direct infection. He favours the idea of a leprous predisposition, which is inherited.

A number of facts are set out in support of this point of view. The leper in Ambon is not debarred from mingling with the rest of the population. He may be a washerman, he may play football with his fellows and he may be either foreman or workman in his regular occupation. The disease is strikingly incident in certain families and might in certain places be called a family disease. Among the requirements put forward for transmission of leprosy by infection are the necessity for long duration of contact and special intimacy. And yet an investigation of 157 marriages, where one or both parties were leprous, showed that 19 had been both affected before marriage and only two could be regarded as having contracted leprosy after marriage. The rarity of occurrence of infection through marriage and the frequency of occurrence in definite families are best explainable, according to the author, by a theory of inherited congenital disposition. He gives an interesting frequency distribution of the appearance of leprosy at years 1–5, 6–10, 11–15, 16–20, 21–25, 26–30, 31–35, 36–40, 41–45, 46–50, 51–55 and over 55 in the numbers 5, 32, 49, 53, 61, 21, 26, 19, 9, 12, 8 and 7 respectively. Leprosy has a peculiar area distribution in regard to its very high degree of occurrence in Leitimor and its low degree in Hitoe. These two portions of the island are connected only by an exceedingly narrow peninsula. The former area is inhabited mainly by Christians and the latter by Mohammedans so that it seems probable that this marked difference is based on some distinctive habit or mode of life. The fish theory of leprosy is only mentioned to be dismissed and the rôle of the rat is suggested for further investigation.

W. F. Harvey.

SMART (A. G. H.). **The State Control of Leprosy.**—*Malayan Med. Jl.* 1933. Dec. Vol. 8. No. 4. pp. 211–218.

The author, who is the Senior Medical and Health Officer, Selangor, first gives interesting historical information regarding legislation in Malaya for the control of leprosy and points out that up to recently segregated lepers could only be released on a medical officer's certificate that the patient was " cured," which was very rarely given. He next discusses antileprosy measures in other countries, with the frequent adoption of the more modern methods of control which are known to readers of this *Bulletin*. In Malaya there are now just over 3,000 lepers undergoing institutional treatment, a death rate up to 1911 of 26 to 30

per cent. has been reduced to 8·4 per cent., and there has been an increase in the notifications with improved conditions and treatment. Since 1929 the policy of attracting lepers to come early "with treatment at special clinics without being arrested and confined" has been approved by the Principal Medical Officer, F.M.S., and discharges of uninfective cases have commenced: a Discharged Leper's Aid Society is advocated for them. Children born to lepers are removed from their parents within 14 days and no case of leprosy is known to have occurred among them. He concludes that the goodwill and confidence of the lepers is being won by these modern methods and "the amazing change that has come about in the care of lepers makes us optimistic for the future." *L. R.*

Ryrie (Gordon A.). **Some Difficulties in Leprosy.**—*Malayan Med. Jl.* 1933. Dec. Vol. 8. No. 4. pp. 238–243.

This is a paper read at a Malaya medical meeting containing general information on the diagnosis, prognosis and treatment of the disease. The author regards the adoption of the intradermal injection of ethyl esters as the most important recent advance. He rightly regards leprophobia as more infectious and harmful than leprosy itself since it leads to the hiding of cases. *L. R.*

Sharp (Leonard E. S.); Downes-Shaw (Alma). **I. "Leprosy in Uganda." 2. "Observations on Leprosy in Teso."**—*East African Med. Jl.* 1934. Jan. Vol. 10. No. 10. pp. 301–307.

In the first of these notes L. E. S. Sharp describes once more the Kigezi Leper Colony in Eastern Uganda, where model villages have been constructed in an isolated area around an administrative centre with a hospital, and with land to cultivate. Families with lepers are taken in and kept under close observation, while schooling is provided for the children. The colony was opened early in 1931 with 25 lepers and by July 1933 they had increased to 380, about one-third of whom were children. Only a portion of them were treated and the rest served as controls, with the result that he has come to the conclusion that the better conditions of life were more effective than drugs in bringing about the improvement or arrest of the disease in more than half the total cases.

In the second note Dr. Downes-Shaw estimates the lepers in Tezo at at least 3,000, of whom 600 have been seen. A hospital for children and out-patient clinics have proved to be of value, but a camp for advanced cases has been replaced with advantage by a colony on the lines advocated above by Dr. Sharp. *L. R.*

Atkey (O. F. H.). La fréquence de la lèpre dans le Soudan en relation avec le climat et le régime alimentaire. [**Leprosy in Sudan in Relation to Climate and Diet.**]—*Bull. Office Internat. d'Hyg. Publique.* 1934. Mar. Vol. 26. No. 3. pp. 490–496.

This is an interesting account of the infrequency of leprosy in north and central Egypt, especially among the Arabs possessing goats and other animals living largely on milk; and its much greater frequency among the negroes without these advantages in both the central and southern areas including the Anglo-Egyptian Sudan. The climate and rainfall will not explain the differences. *L. R.*

VAN CAMPENHOUT (E.). La lutte contre la lèpre au Congo Belge. [**Measures against Leprosy in Belgian Congo.**]—*Bull. Office Internat. d'Hyg. Publique.* 1934. Mar. Vol. 26. No. 3. pp. 497–498.

Leprosy is widespread in the hot humid Belgian Congo, and especially in the Nepoko region. The Red Cross Society has developed the work of prophylaxis by erecting 6 hospitals, 28 dispensaries and 2 homes for leper mothers. Antileprous centres consist of three agricultural villages, with land to cultivate to render them largely self-supporting, and placed about six miles apart with good communications to allow of modern methods of medical care under a sanitary agent and a medical officer. During the last seven years surveys have revealed 4,600 lepers in a population of 443,700, or a little over 10 per mille. The extension of the system of getting as many lepers as possible into the leper village settlements appears to be the most promising way of dealing with the problem. *L. R.*

LEGER (Marcel). La lèpre dans nos colonies tropicales d'Amérique. [**Leprosy in the French Colonies of America.**]—*Rev. Prat. Malad. des Pays Chauds.* 1934. Feb. 13th Year. Vol. 14. No. 2. pp. 637–644, 647–652, 655–656, 659.

A brief history of leprosy and leprosaria in French Guiana, Guadeloupe and Martinique is first given, in the light of which prophylaxis is considered. The author points out that two centuries of compulsory segregation has failed even to prevent the slow increase of the disease, but that much milder measures succeeded in Norway. He therefore advocates the adoption of the modern methods of treating cases in their early stages in a number of local dispensaries, and the medical inspection of schools, together with compulsory notification by the doctors with strict guarding of professional secrecy, in place of iniquitous and arbitary measures based on disguised segregation. *L. R.*

GRIZAUD. Quelques réflexions sur une léproserie de l'Atlantique : (La Désirade Guadeloupe). [**A Leprosarium in the Atlantic : Desirade.**]—*Ann. de Méd. et de Pharm. Colon.* 1933. Oct.–Nov.–Dec. Vol. 31. No. 4. pp. 551–558.

A description of the situation and bad conditions of the Desirade leper Island, Guadeloupe, an arid, waterless spot, is given, and the patient work by means of which the confidence of the unfortunate patients was obtained. Some degree of amelioration through treatment is described. The lepers here isolated compulsorily number 70, 52 of whom are now being treated regularly. *L. R.*

LAMPE (P. H. J.). Voordrachten over de endemiologie der lepra. [**Lectures on the Endemiology of Leprosy. I. Historical Survey.**] —*Geneesk. Tijdschr. v. Nederl.-Indië.* 1934. Mar. 13. Vol. 74. No. 6. pp. 332–338. English summary.

Leprosy in a historical and therefore endemiological sense is as old as the world. Its endemiology has manifested changes with the changes of medical opinion and certain important events or discoveries serve to mark off the periods of these changes. The first period extends from the beginnings of history up to 1850 and may be described as a

time of confusion with other diseases and of a popular belief in its infectivity. During this time leprosy or elephantiasis graecorum was confused with elephantiasis arabum (filariasis), syphilis, yaws and skin affections such as the ringworms. During the second period, 1850–1875, dominated by the standard work of DANIELLSEN and BOECK, which appeared as a French translation in 1848, the doctrine of hereditary transmission of leprosy was in vogue. This was subscribed to by a British commission in 1862. One of the main arguments against the earliest view of the infectivity of leprosy was the absence of conjugal transmission. It was also contended that the majority of sufferers from leprosy were to be found in leper families, averaging 70 per cent. The theory of infectivity, however, still found expression in this period, although the great pathologist VIRCHOW contended for an unknown etiology. The third period 1875–1900 was one of important and definite change. In 1871 HANSEN discovered the leprosy bacillus 10 years before the discovery of the tubercle bacillus by KOCH. A second British commission in 1875 now declared unanimously for the infectivity of leprosy and this was also the pronouncement of the first international leprosy conference in Berlin in 1897. Two other periods may be marked off in this survey of the history of leprosy. The fourth period, which lasted from 1900 to 1930, saw the infective theory generally adopted, diversion of studies to the treatment of leprosy, conferences on leprosy and the foundation of the Leprosy Commission of the League of Nations. During this period there arose the idea that, to the extent to which individual cure is more difficult of attainment, to that extent prevention becomes more worth while. A short fifth period is given by the author as commencing in the previous period and extending to the present day in which there has been renewal of the study of endemiology, a study of the factors concerned in active tranmission and of " the conditions which produce the disposition to development of manifest leprosy." *W. F. Harvey.*

LAMPE (P. H. J.). Voordrachten over de endemiologie der lepra. [**The Endemiology of Leprosy.**]—*Geneesk. Tijdschr. v. Nederl-Indië.* 1934. Mar. 27. Vol. 74. No. 7. pp. 415–422. English summary.

The author discusses the differences of opinion regarding the virus of leprosy, and whether the acid-fast bacillus or an ultra-virus or granule phase is the infective agent, but he does not come to any conclusion. *L. R.*

KEIL (E. C.). **The Importance of Nutrition in the Prevention and Cure of Leprosy.**—*Internat. Jl. Leprosy.* Manila. 1933. Oct. Vol. 1. No. 4. pp. 393–398. With 3 figs. on 1 plate.

The author recalls that as early as the 17th century Dutch physicians in Surinam held that there is a causal relationship between diet and leprosy and this belief still survives there. A good nutritious diet is of especial importance in childhood when leprosy is so often contracted. In Surinam and other tropical climates the diet is essentially one of polished rice with a little salted meat or fish, but it should be rich in vitamins, certain mineral salts, and fats with a limited amount of carbohydrates. He therefore advises nutritional care to allow of lasting results in the treatment of leprosy, but does not record any experience of its use. *L. R.*

Jeanselme (E.). Des connaissances acquises en léprologie depuis le milieu du siècle dernier. [**The Knowledge acquired on Leprosy since the Middle of the Last Century.**]—*Rev. d'Hyg. et de Méd. Préventive.* 1934. May. Vol. 56. No. 5. pp. 321–331.

This is an interesting historical paper which is itself a summary so cannot well be abstracted. The distinguished author takes the opportunity to draw attention to his recently published monumental work on leprosy.

L. R.

Molesworth (E. H.). **The Influence of Natural Selection on the Incidence of Leprosy.**—*Internat. Jl. Leprosy.* Manila. 1933. July. Vol. 1. No. 3. pp. 265–282. [22 refs.]

The following is the author's summary of his conclusions on this theoretical subject :—

" 1. By appeal to the laws of natural selection and application of the herd experiments of Topley and Wilson it has been shown that natural resistance is necessarily raised by leprosy through the elimination of the great majority of susceptibles in an infected race.

" 2. The behavior of leprosy in this respect has been shown to be analogous to that of other diseases, like measles and tuberculosis.

" 3. It has been shown that natural resistance supplies an explanation for otherwise anomalous events in the history of leprosy, events that cannot be explained satisfactorily by any other hypothesis unless it be admitted that natural selection is also in operation.

" 4. Natural selection was probably the dominating influence in determining the present freedom of Europe from leprosy." *L. R.*

Montañés (P.) & Negro (E.). Primer síntoma objetivo en los leprosos españoles. [**The First Objective Symptom of Leprosy.**]—*Rev. San. e Hig. Pública.* 1934. Mar. Vol. 9. No. 3. pp. 210–215.

This study of 417 lepers in Spain—about 25 per cent. of the total—is of interest in that, in the slow march of the disease, the early symptoms are often forgotten. The authors go further than merely determining the first symptom, they are of opinion that the information obtained is of prognostic and therapeutic value.

They found that maculae were far the most common, occurring in 126 or 30·2 per cent. of the patients investigated ; tubercles were next, but a considerable way below, in 67 or 16·0 per cent. These were first seen most commonly on the face and then, in order, the lower limb, upper limb and trunk.

Next commonest were neuritis, in 50 or 11·9 per cent., pemphigus 40 (9·5), most often on the legs, later on the arms. In no case did the pemphigus occur on the face and neuritis of the face was very rare. After these there followed rhinitis in 35 (8·5 per cent.) " acute " (*i.e.*, lepra reaction) in 22 (5·0), and loss of eyebrows in 17 (4·7). Other forms such as anaesthesia, oedema of legs and ulcers were very rare in their experience (from 3·1 to less than 1 per cent.).

Prognostically, the authors state that a beginning with maculae, tubercles, rhinitis, lepra reaction or loss of eyebrows indicates a severe cutaneous form, probably of shorter duration than the nervous variety and liable to painful intercurrent lesions. On the other hand early symptoms of neuritis, pemphigus, anaesthesiae, indicate the nerve type, and a milder disease, with little or no tendency to intercurrent affections and likely to have a course more prolonged.

Also, if the commencement is by rhinitis, loss of eyebrows, or the acute form great care must be exercised in treatment, as these are usually associated with bacilli in large numbers and their evolution is rapid. Those with early pemphigus and neuritis have fewer bacilli and are of slower evolution and exhibit a greater tolerance in treatment. *H. H. S.*

Tisseuil (J.). Syndrome lépreux chez les malades contaminés a l'âge adulte. [**Leprosy in Patients infected as Adults.**]—*Bull. Soc. Path. Exot.* 1934. Mar. 14. Vol. 27. No. 3. pp. 215–220. With 1 fig.

The author records and comments on six adult males developing leprosy between the ages of 40 and 61 in French Guiana. The lesions were a few small unthickened patches, with some alterations in the sensation, of a pale-red lilac colour and becoming more evident on exposure for a time to the air, and he regards them as a mild modified form of the disease occurring in those infected late in life. *L. R.*

Ishizu (Shun). Ueber Alopecia leprosa. (Histologische Untersuchung.) [**Leprous Alopecia : its Histology.**]—*Japanese Jl. Dermat. & Urol.* 1933. Sept. Vol. 34. No. 3. [In Japanese pp. 261–320. With 35 text figs. & 35 figs. (11 coloured) on 3 plates. [53 refs.] German summary pp. 48–60.]

This paper records a minute description of the histology of leprous alopecia which should be read in the original by those interested in its subject. *L. R.*

Cole (Howard Irving). **Chemistry of Leprosy Drugs.**—*Internat. Jl. Leprosy.* Manila. 1933. Apr. Vol. 1. No. 2. pp. 159–194. [124 refs.]

This is the first of a series of comprehensive reviews of different aspects of the leprosy question to be published in the *International Journal of Leprosy*. It should be read by all interested in the subject as it deals with the literature from 1904 to date and includes 124 references. The Chaulmoogra group is first dealt with at length, and is followed by an account of the use of antimony, arsenic, copper and gold preparations, iodides, mercurial and other inorganic compounds, organic compounds and synthetic products. *L. R.*

Muir (Ernest). **Treatment of Leprosy. A Review.**—*Internat. Jl. Leprosy.* Manila. 1933. Oct. Vol. 1. No. 4. pp. 407–458. With 2 figs. & 2 plates. [257 refs.]

This is the second review of the series of an equally comprehensive nature, as it includes vaccines and serums, chaulmoogra and other oils, iodides, the heavy metals and a variety of other drugs, surgical and other local treatments. The factors modifying the disease, as lepra fever, are dealt with, and a valuable section is that on the evaluation of treatment in which the numerous sources of fallacy are pointed out. General, regional and operative treatment, and the control of patients during treatment and after discharge conclude a very valuable review by a master of his subject. *L. R.*

EMERSON (G. A.) & SALLE (A. J.). **In Vitro Leprocidal Activity of Some Non-Chaulmoogryl Compounds.**—*Proc. Soc. Experim. Biol. & Med.* 1934. Jan. Vol. 31. No. 4. pp. 428–433. [Refs. in footnotes.]

The activity of over 200 compounds *in vitro* has been tested on a culture of "M. leprae hominis" isolated by E. L. WALKER in California. in the medium of Long and Seibert. The first group was a series of dyes, and he mentions that trypan blue was ineffective, as were eosin and fluorescin. Mercurochrome had a high activity, but acriflavine little. The second group were metallic organic compounds and Hg, Sb, Au, Ag, and Cu organic compounds showed high activity. Pentavalent arsenical compounds were without effect, but arsphenamine is highly active. Iodides were only active in concentrations of 1 per cent. The third group were selected for properties which in the chaulmoogric acid derivatives have been held to cause the peculiar activity of the molecule, such as highly unsaturated compounds and those containing 16–18 carbon atoms and the results are shown in a table. The fourth group included fatty acids other than chaulmoogra; these are also tabulated. They are now testing the action of the more promising compounds experimentally in leprous rats. *L. R.*

NOLASCO (J. O.). **Lymphatic Absorption of Iodized Ethyl Esters of Wightiana Oil by Intramuscular Injection.**—*Jl. Philippine Islands Med. Assoc.* 1933. Dec. Vol. 13. No. 12. pp. 552–557.

In view of the previous demonstration that Hydnocarpus esters injected intradermally or subcutaneously can be demonstrated as yellow globules in tissues and lymphatic glands, the author has investigated in monkeys the absorption of the drugs, and he found that those injected intragluteally were present in the lumbar, but not in the inguinal glands, and those inserted into the deltoid and triceps muscles only reached a portion of the axillary glands. As leprosy bacilli may be found in various lymphatic glands he advocates a much wider distribution of the injections so as to obtain absorption of the drug through as many as possible of the glands of the body. *L. R.*

ANDRÉ (Z.) & LABERNADIE (V.). Essais de traitement de la lèpre et de la tuberculose par des injections intraveineuses d'huile de chaulmoogra. (2e note). [**Treatment of Lepers by Intravenous Injections of Chaulmoogra Oil.**]—*Bull. Soc. Path. Exot.* 1933. Dec. 13. Vol. 26. No. 10. pp. 1234–1235.

In this brief note the authors report having given 595 intravenous injections of *Hydnocarpus wightiana* oil, either neutralized or with 10 per cent. gum solution, with no injury to the veins or symptoms of embolism, and that in leprosy cases raised skin lesions subsided after a few injections. *L. R.*

BARTMAN (J.). Essai de traitement de la lèpre par de fortes doses des éthyls-éthers de l'huile de chaulmoogra. Essai de traitement par l'iode. [**Treatment by Strong Doses of Chaulmoogra Ethyl Esters or by Iodine.**]—*Ann. Soc. Belge de Méd. Trop.* 1934. Mar. 31. Vol. 14. No. 1. pp. 7–18.

Five macular and one nerve case were treated with very large doses of up to 20 cc. of chaulmoogra ethyl esters without any benefit except

temporary improvement in the nerve case. He then tried giving up to 150 drops in 3 doses daily of 10 gm. iodine in 100 gm. of 94 per cent. alcohol in 17 cases, with or without previous esters, and he obtained uniform improvement of the macules, which became lighter in colour and less prominent. *L. R.*

BERNARD (P.). Deux cas de lèpre traités par des injections intradermiques d'éther de chaulmoogra créosote. [**Two Leprosy Cases treated with Esters Intradermally.**]—*Bull. Soc. Path. Exot.* 1933. Dec. 13. Vol. 26. No. 10. pp. 1235–1237.

In view of the good results reported from the Philippines and Calcutta following intradermal injections of hydnocarpus esters the author tried them in two cases with beneficial results on the thickened skin patches and on anaesthetic areas. *L. R.*

READ (Bernard E.). **The Toxicity of Sodium Hydnocarpate.**—*Internat. Jl. Leprosy.* Manila. 1933. July. Vol. 1. No. 3. pp. 293–307. With 3 figs. [14 refs.]

After reference to earlier work on excessively large doses in animals causing toxic changes in the kidney, tests with doses more closely corresponding to those in use in man were made on rabbits and dogs with two preparations, firstly alepol (of which some half million doses have been supplied yearly to British possessions for some years past) and secondly one made from the palmitin-free relatively-lower-melting-point fatty acids of Taraktogenos oil; the latter proved the more toxic of the two. The conclusion is come to that long continued use of these preparations has a cumulative action and injuriously affects the kidneys and livers of the animals used in the tests, while ethyl esters were also not without harmful effects. Care therefore is required in selecting suitable concentrations and dosage in leprosy, and large doses of high concentration with a view to saturating the system are of doubtful value. *L. R.*

BERNY (P.). Effet comparatif de l'iode sur le rat sain et sur le rat lépreux. [**The Comparative Effect of Iodides on Healthy and Leprous Rats.**]—*Bull. Soc. Path. Exot.* 1933. Dec. 13. Vol. 26. No. 10. pp. 1237–1239.

In view of the recorded intolerance of tubercular patients to iodides the author has worked out the minimal lethal dose of injections of potassium iodide, and found it to be nearly three times as great in healthy as in leprous rats. *L. R.*

MONTEL (R.). Un nouveau traitement de la lèpre. Note préliminaire. [**A New Treatment of Leprosy.**]—*Bull. Soc. Path. Exot.* 1934. Mar. 14. Vol. 27. No. 3. pp. 220–222.

Intravenous injections of 1 per cent. methylene blue have given good immediate results in four cases of leprosy, but it is too early to say what the ultimate results will be. The dye has a selective action on leprous lesions; lepromes rapidly subsided and softened, erythematous patches faded and thickened nerves became smaller with improvement in sensation. *L. R.*

Feron (J.). Action d'un complexe cupro-cinnamique sur quelques manifestations de la lèpre en Ethiopie. [**A Copper Cinnamon Compound in Leprosy.**]—*Bull. Soc. Path. Exot.* 1934. Feb. 14. Vol. 27. No. 2. pp. 120–127. With 6 figs.

The author reports on the intravenous injection in 200 Ethiopian lepers of 3 cm. ampoules of " zimbyl-cuivre " with amelioration of the general health and of the sensory troubles, but no effect on advanced nodular cases. *L. R.*

Reitz (H.). **The Percutaneous Treatment of Leprosy.**—*Jl. Philippine Islands Med. Assoc.* 1933. Nov. Vol. 13. No. 11. pp. 511–527. With 16 figs. on 4 plates & 3 charts.

This paper is remarkable for claiming good results, supported by some photos, " with a substance of suitable character " based on the principle that it should be soluble in the cholesterine fats of the skin and consequently be absorbed on being rubbed by the patient into the skin lesions, yet no mention is made of the actual preparation used. *L. R.*

Paldrock (A.) & Pooman (A.). Die Beeinflussung der Lepraerreger durch Natriumthiosulfat. [**Sodium Thiosulphate in Leprosy.**]—*Dermat. Woch.* 1934. Apr. 7. Vol. 98. No. 14. pp. 417–419. With 1 fig.

The authors report on a trial of sodium thiosulphate in leprosy and conclude that it is ineffective. *L. R.*

Chatterji (S. N.). **Thickened Nerves in Leprosy in Relation to Skin Lesions.**—*Internat. Jl. Leprosy.* Manila. 1933. July. Vol. 1. No. 3. pp. 283–292. With 10 text figs. & 7 figs. on 2 plates.

The clinical findings as regards thickening of the superficial nerves in a total of 3,079 cases, with such nerve lesions in 1,024, or 33 per cent., are discussed ; in 542 more than one nerve was involved. Deep analgesia is usually less than superficial anaesthesia, but the latter persists longer in recovering cases. In the ascending type of nerve lesion the infection spreads by the lymphatics, and the whole length of nerves supplying anaesthetic patches should be palpated to detect thickening, as its occurrence is important in the diagnosis. In prognosis this lesion indicates a chronic case likely to improve slowly, and also activity of the disease requiring further treatment and the danger of a relapse if the patient is prematurely discharged. *L. R.*

Muir (E.) & Chatterji (S. N.). **Leprous Nerve Lesions of the Cutis and Subcutis.**—*Internat. Jl. Leprosy.* Manila. 1933. Apr. Vol. 1. No. 2. pp. 129–148. With 1 text fig. & 10 figs. on 5 plates. [13 refs.]

This paper should be read in conjunction with the foregoing one as it deals with the microscopical appearances in leprous thickened nerves, based on serial section of eight cases in which the edge or the whole of nerve dermal patch was removed to allow of early nerve lesions being studied. Thickened granulomatous cords were traced from the subcutaneous tissues into the cutis, and they often contained giant cells, but few or no bacilli ; necrosis, caseation or cold abscess formation may occur in them. As they regard these as the earliest nerve lesions they suggest a minute and possibly filtrable ultra-microscopical stage of the *M. leprae* as the cause of the infection in the early stages. *L. R.*

DES ESSARTS (J. Quérangel) & LEFROU (G.). Notes sur l'histologie des macules anesthésiques de la lèpre. [**Histology of Macules.**]—*Bull. Acad. Méd.* 1934. Apr. 17. 98th Year. 3rd Ser. Vol. 111. No. 14. pp. 532–535.

Sections of anaesthetic macules revealed characteristic lesions of diagnostic importance (in the frequent absence of lepra bacilli, which were only found in 18 per cent. of the cases) namely, lightly coloured nodules in the skin formed of epitheloid cells, capillaries and vacuoles as formerly described by VIRCHOW and by DARIER. *L. R.*

DE JONG (R. de Josselin). Over tropho-neurotische atrophie in beenderen. (Naar aanleiding van een onderzoek van organen bij een lijder aan lepra mutilans.) [**Neurotrophic Atrophy of Bones in Leprosy.**]—*Nederl.-Tijdschr. v. Geneesk.* 1934. Apr. 21. Vol. 78. No. 16. pp. 1720–1727. With 10 figs. on 4 plates. French summary (7 lines).

A description is given of a chronic nerve case of leprosy with extensive atrophy of the bones of the feet and hands with illustrations of the macro- and micro-scopical changes. He considers the lesions to be due to a neurotrophic atrophy due to the action of inflammatory changes in the peripheral nerves. *L. R.*

SARDJITO & SITANALA (J. B.). Een verdere studie over leprabacillen in den dikken bloeddruppel genomen van normaal uitziende huid van leprozen. [**A Further Study of Leprosy Bacilli in the Thick Blood Drop from Apparently Normal Skin in Lepers.**]—*Geneesk. Tijdschr. v. Nederl.-Indië.* 1934. Jan. 16. Vol. 74. No. 2. pp. 91–102. [10 refs.]

Acid-fast bacilli have now been demonstrated in thick blood drops taken from the unaffected skin of sufferers from nodular leprosy by many observers. It has further been shown that many more bacilli are present in the blood-drop film than in serum obtained by a prick of the margin of the ear after rendering it anaemic by clamping with a forceps. Upon pricking the anaemic skin an oozing of serum is obtained from which films are made, and by relaxing the clamp a flow of blood occurs which serves for the thick blood-drop preparation. Special importance is attached to the presence of the large numbers of bacilli in the blood drop, for it is taken to indicate that leprosy bacilli are circulating in the blood and present in the blood capillaries before they secondarily invade the tissues to give rise to lepromata. This is why a serum film from apparently sound skin shows fewer bacilli than the blood from the same part, for the bacilli are in capillaries, not in the tissue fluid. A number of sufferers too from nerve leprosy show the same thing, although not to the degree that obtains in nodular leprosy.

W. F. Harvey.

STEIN (A. A.) & STEPERIN (M. I.). Om leprabacillenes utskillelse hos spedalske. [**Excretion of Leprosy Bacilli by Lepers.**]—*Norsk. Mag. f. Laegevidenskapen.* 1934. Mar. Vol. 95. No. 3. pp. 278–280.

The investigations recorded in this paper were conducted at the "Krutijje Rutschji" leper hospital near Leningrad. It was found

that the bacillus of leprosy could be demonstrated in the skin of lepers even in those areas where it had not, apparently, been diseased.

The technique adopted for the bacteriological examination of the fluid constituents of the skin was as follows: The skin was incised with a scalpel so superficially that no blood was drawn, only lymph. Another way of obtaining lymph was to provoke vesicles by freezing with carbonic acid snow. Both these procedures were applied to the apparently healthy skin of the upper arm where, according to the patients' statements, there had never been any rash. At the same time a bacteriological examination was made of the nasal mucosa of all the 97 patients, and of the 49 members of the staff of the hospital. The findings, recorded in 5 tables, emphasize the dominant rôle played by the nasal mucosa in the excretion of the bacillus of leprosy. In 11 cases it was found in the nasal mucosa in the absence of any macroscopic changes in it. The two methods of examining the skin already described yielded positive results in a considerable proportion of cases and, what was still more important, the bacillus of leprosy was found by this means in three patients who no longer showed any other sign of leprosy, and in whose nasal mucosa this bacillus could no longer be found even after the exhibition of potassium iodide. These findings show how very careful the medical officer of a leprosy hospital must be in his examination of patients before giving them their discharge. Although Pawlow and others have demonstrated the bacillus of leprosy in members of the staffs of leper hospitals, none of the 49 attendants examined by the authors was found to harbour this bacillus, although the nasal mucosa was examined repeatedly in the case of the doctors and nurses. *C. Lillingston.*

Arizumi (Saburo). **On the Blood Picture of Lepers.**—*Taiwan Igakkai Zasshi* (*Jl. Med. Assoc. Formosa*). 1933. Nov. Vol. 32. No. 11 (344). [In Japanese pp. 1549–1566. [24 refs.] English summary pp. 154–155.]

In leprosy the red corpuscles are reduced in numbers and a fairly high proportion of basophil-punctated and polychromatophils are found, together with some anisocytosis and a few poikilocytes, but no nucleated forms. The leucocytes were always increased, especially in advanced active nodular cases, with some decrease in the lymphocytes, and the eosinophiles are few but may become increased. The haemoglobin is decreased in proportion to the activity of the cases, and the haemoglobin index is rather low. *L. R.*

Iswariah (V.) & Nair (V. G.). **Observations on Erythrocyte Sedimentation with Special Reference to Leprosy.**—*Jl. Indian Med. Assoc.* 1934. Feb. Vol. 3. No. 6. pp. 231–235. With 5 graphs.

The authors have studied the sedimentation rate of the red corpuscles in the citrated blood of lepers and they disagree with the conclusions of Muir and others [see this *Bulletin*, Vol. 27, p. 338], for they found the rate did not give a reliable indication for treatment and that cases with a high rate did well with regular hydnocarpate treatment. *L. R.*

LEFROU (G.) & BONNET (P.). Déséquilibre protéique du sérum sanguin dans la lèpre. [**Blood Proteins in the Blood of Lepers.**]—*Bull. Acad. Méd.* 1934. Jan. 30. 98th Year. 3rd. Ser. Vol. 111. No. 4. pp. 175–177.

—— & ——. L'équilibre protéique du sérum sanguin des lépreux.—*Bull. Soc. Path. Exot.* 1934. Jan. 10. Vol. 27. No. 1. pp. 35–45. [Refs. in footnotes.]

—— & ——. Les modifications de l'équilibre protéique du sérum sanguin comme élément de diagnostic précoce de la lèpre.—*Bull. Acad. Méd.* 1934. Mar. 27. 98th Year. 3rd Ser. Vol. 111. No. 12. pp. 433–435.

The first two of these papers deal with estimations of the total proteins and of the proportion of serum globulin and of serum albumin in 65 lepers, in 28 of whom only were lepra bacilli found, and many showed only nerve symptoms and anaesthetic patches. Nevertheless, in all of them characteristic blood changes were found in that the total amount of albumen is normal or increased, the serum globulin was always increased, but the serum albumin was normal or diminished. In the third paper the diagnostic value of this blood change is discussed and the conclusion is come to that while the change is not specific, as it may be present in syphilis, tubercle and cancer, yet it is of diagnostic value when any signs of leprosy are present, since the Vernes reaction will usually allow syphilis to be excluded. *L. R.*

i. DUVAL (C. W.) & HOLT (R. A.). **Failure to enhance the Growth of *B. leprae* by Wherry's Gaseous Method (Co_2, O_2 Environment).**—*Proc. Soc. Experim. Biol. & Med.* 1934. Jan. Vol. 31. No. 4. pp. 453–455.

ii. HOLT (Rebie A.). **Studies with Chick Embryo Tissue in Cultivation of *B. leprae*.**—*Ibid.* Feb. No. 5. pp. 567–569.

i. Duval and Holt record their failure to confirm the recent claims of WHERRY, and of SOULE and MCKINLEY [this *Bulletin*, Vol. 29, p. 549 ; Vol. 30, p. 238] that an environment of CO_2 and O gases enhances the growth of *M. leprae*, for they could obtain no evidence of any influence of these gases on the growth of the bacilli.

ii. In the second note, Holt records that he could obtain no clear evidence of any multiplication of the *M. leprae* in chick embryo tissue cultures, as claimed by MCKINLEY and VEDER, and he points out the difficulties in estimating whether any actual multiplication of the organisms has taken place, due to concentration of them with the autolysing of the leprous tissue present and other fallacies. He even found evidence of degeneration and loss of viability after four months in such culture media, and concludes that in his experience chick-embryo tissue emulsified in Tyrode's solution is *per se* valueless as a nutritive in the *in vitro* cultivation of *M. leprae*. *L. R.*

HOLT (R. A.). **Use of Living Chick Embryos in the Propagation of *B. leprae*.**—*Proc. Soc. Experim. Biol. & Med.* 1934. Mar. Vol. 31. No. 6. pp. 643–645.

——. **Morphological Resemblance of the Rod Shaped Pigment of the Chick Retina to *B. leprae*.**—*Ibid.* pp. 645–648. With 4 figs.

In the first of these notes the author reports an attempt to cultivate lepra bacilli of nodules by GOODPASTURE's method of inoculating

incubated fertile hens' eggs upon the chorio-allantoic membrane, but he could obtain no evidence of multiplication of the bacillus.

In the second note he gives illustrations of the microscopical resemblances between the globi of leprous nodules and the rod-shaped pigment within the epithelial cells of the retina of embryo chicks, but they can be distinguished by Ziehl-Neelsen staining. *L. R.*

Salle (A. J.) & Moser (J. R.). **Bacteriology of Leprosy. II. Growth and Staining Reactions of Organisms inoculated into Minced Chick Embryo Medium.**—*Proc. Soc. Experim. Biol. & Med.* 1934. Mar. Vol. 31. No. 6. pp. 725–726.

—— & ——. **III. Growth and Staining Reactions of Acid Fast Organism inoculated into Minced Animal Tissues.**—*Ibid.* pp. 727–728.

In the first of these short notes the authors report that on cultivating acid-fast organisms isolated from human and rat leprous lesions on fresh tissue cultures and in minced embryo medium both acid-fast and non-acid-fast organisms are found during the first two days, but the acid-fasts then diminished and nearly disappeared by the tenth day, On transferring to fresh similar media the same thing is repeated, but this does not occur with numerous other non-acid-fast bacteria on the same media. As both human and rat bacilli behave in the same way they think those infections are caused by the same bacilli.

In the second note they record the use of minced organs of rabbits, guineapigs and rats in Tyrode solution as culture media for lepra bacilli, and they obtained good growth in the two former but not in the rat tissues; the organisms lost their acid fastness in about five days. They therefore conclude that living embryonic tissues are not necessary for obtaining cultures. *L. R.*

Hoffmann (W. H.). **The Granular Forms of the Leprosy Bacillus.**—*Internat. Jl. Leprosy.* Manila. 1933. Apr. Vol. 1. No. 2. pp. 149–158. With 4 figs. on 1 plate.

From a study of the granular forms of the leprosy bacillus the author concludes that the well-known granules within the bacilli, and as free-lying bodies, are a part of its evolutionary cycle, and as they vary in size down to the limits of visibility it is possible that invisible and filterable forms exist of unknown significance. It is also possible that they are the result of degeneration and disintegration of the bacilli, due in part to the defensive mechanism of the organism and in part to the action of medicinal products, and especially of chaulmoogra oil, in which case their presence can be considered a favourable sign. He, however, thinks they should not be considered solely as degenerate forms, for in some cases they seem to be especially resistant or young forms, and may even serve to propagate and preserve the species or be responsible for relapses. Their true nature will only be discovered by further investigations. *L. R.*

Peschkowsky (J. W.). Ueber Reaktionen bei Lepra. [**Leprosy Reactions.**]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1934. Mar. Vol. 38. No. 3. pp. 112–118.

The cellular changes in leprosy reactions are discussed and the author finds that a monocytosis is unfavourable clinically and prognostically,

but a lymphocytosis is more favourable. An increase of the polynuclears in the blood with enlargement of the glands, which may break down, accompanied by destruction of the lepra bacilli, may result in a temporary increased immunity developing in the course of the disease.

L. R.

Laigret (J.). Réactions des lépreux vis-à-vis de certains extraits du bacille de la lèpre des rats. [**Reactions of Lepers to Intradermal Injections of Rat Leprosy Bacilli.**]—*Arch. Inst. Pasteur de Tunis.* 1933. Dec. Vol. 22. No. 4. pp. 509–512.

Sterilized suspensions of rat leprosy bacilli were injected intradermally into three cases of mixed and one of nodular leprosy, and control injections were made in healthy and tuberculous subjects. Positive reactions in the form of congestion, sometimes accompanied by papules or even ulceration persisting for several weeks, occurred in 3 of the 4 lepers, in 1 of 2 normal subjects, and negative ones in the remainder, so no conclusions are possible. An antigen was also made from the rat leprosy bacilli for complement deviation tests with the serums of lepers, with positive results in 3 lepers, in 2 leprous rats, in 2 of 6 tuberculous cases and in 3 of 4 syphilitic serums. He concludes that a negative reaction will exclude leprosy, but a positive one will only be of value if tubercle and syphilis can be excluded. *L. R.*

Yoshimura (Yasunori). Ueber die Funktion der Schweissdrüsen an der leprösen Flecke. [**Function of Sweat Glands in Leprous Patches.**]—*Japanese Jl. Dermat. & Urol.* 1934. Feb. Vol. 35. No. 2. pp. 105–156. With 37 figs. [80 refs.] [In Japanese. German summary pp. 17–18.]

This paper describes the changes in the sweat glands in leprous patches and should be read in the original by those interested. *L. R.*

i. Bernard (P.). Leucocytes et bacilles de Stéfansky dans le péritoine du rat et du cobaye.—*Bull. Soc. Path. Exot.* 1934. Jan. 10. Vol. 27. No. 1. pp. 12–17.

ii. ——. Localisation des bacilles de Stéfansky injectés dans la veine du rat.—*Ibid.* Feb. 14. Vol. 27. No. 2. pp. 117–120.

iii. Chorine (V.). Conservation du bacille de Stéfansky.—*Ibid.* Mar. 14. Vol. 27. No. 3. pp. 222–224.

iv. Tisseuil (J.) & Chorine (V.). La coloration par la fuchsine ne tue pas le bacille de Stéfansky.—*Ibid.* pp. 224–225.

v. Laigret (J.). Reproduction de la lèpre murine chez le cobaye et chez le lapin, traités par un extrait acétonique de bacilles tuberculeux. [**Investigations on Rat Leprosy.**]—*C. R. Acad. Sci.* 1933. Dec. 4. Vol. 197. No. 23. pp. 1468–1470.

i. In this short note Bernard records the leucocyte response to the intraperitoneal injection of Stefansky's bacillus of rat leprosy in rats and in guineapigs. In the former there is a great majority of lymphocytes, but in the guineapig the original high lymphocyte count is replaced by an increase of the polynuclears after four hours. A phagocytic action occurs, especially in the polynuclears, which undergo degenerative changes.

ii. This note records that Stefansky's bacilli were injected into the tail vein of rats and their subsequent distribution in the tissues of the

body was investigated. They were found to accumulate especially in the liver in the cells of Kupffer, which appear to destroy a portion of the organisms within 24 hours. In the spleen they are found in the venus sinuses at the periphery of the Malpighian bodies, where they become absorbed by the macrophages. They traverse the lungs, kidney and brain without being retained in them.

iii. The author recalls that E. MARCHOUX showed that the pathogenicity of the rat leprosy bacillus can be maintained in 40 per cent. glycerine in ice for 18 months, and at his request the author determined the limit of such preservation and found they survived up to 29 months, but not up to 51 months.

iv. Tisseuil and Chorine have found that staining Stefansky's bacillus by fuchsine does not kill it as they can still produce the disease in rats.

v. The author records the successful production of rat leprosy infection in previously refractory animals, guineapigs and rabbits, by treating them with acetone extracts of B.C.G. after injection with Stefansky's bacillus. *L. R.*

GILLIER (R.) & TISSEUIL (J.). Essais de traitement de la lèpre du rat. Troisième série. [**Treatment of Leprous Rats.**]—*Bull. Soc. Path. Exot.* 1934. Feb. 14. Vol. 27. No. 2. pp. 189–199.

Rats were infected by injections of material containing Stefansky's bacillus and treatment was commenced eight days later. Only retardation of the evolution of the disease was obtained by the following preparations classed in order of efficacy: tubercular extracts in methyl alcohol and in acetone, chlorides of nickel and of cadmium, and sulphate of cobalt and ammonium. *L. R.*

BRITISH EMPIRE LEPROSY RELIEF ASSOCIATION. The Shadow of Leprosy: being the Annual Report for 1933 of the British Empire Leprosy Relief Association. —32 pp. With 6 figs. London; 29 Dorset Square, N.W.1.

DELANOË (E.). Traitement mixte de la lèpre tubéreuse, chez une femme marocaine.—*Bull. Soc. Path. Exot.* 1934. Feb. 14. Vol. 27. No. 2. pp. 127–133.

GRAMBERG (K. P. C. A.). De beteekenis van de polikliniek in den strijd tegen de lepra op Java.—*Geneesk. Tijdschr. v. Nederl.-Indië.* 1934. Mar. 13. Vol. 74. No. 6. pp. 325–332.

MONTAÑES (P.) & NEGRO (E.). El test-histamina en el diagnostico precoz de las manchas leprosas.—*Rev. San. e Hig. Pública.* 1934. Jan. Vol. 9. No. 1. pp. 11–15.

PALDROCK (A.). Ulcera ventriculi bei einer Leprösen.—*Dermat. Woch.* 1934. Feb. 24. Vol. 98. No. 8. pp. 241–242. With 3 figs.

STEIN (A. A.) & STEPERIN (M. I.). Om leprabacillenes utskillelse hos spedalske.—*Norsk. Mag. f. Laegevidenskapen.* 1934. Mar. Vol. 95. No. 3. pp. 278–280.

VAAMONDE FERNANDEZ (J.). Contribución al estudio de la lepra en Galicia.—*Rev. San. e Hig. Pública.* 1934. Feb. Vol. 9. No. 2. pp. 97–107.

VIGNE (Paul) & DUSAN (J.). Un cas de lèpre décelé par la réaction de Rubino.—*Marseille-Méd.* 1933. Nov. 5. Vol. 70. No. 31. pp. 515–517.

SLEEPING SICKNESS.

BARLOVATZ (A.). **Course, Prognosis and Classification of Human Trypanosomiasis.**—*Ann. Trop. Med. & Parasit.* 1934. Mar. 29. Vol. 28. No. 1. pp. 1–20. With 1 chart.

It is customary to divide sleeping sickness into three periods, which are believed to succeed each other : the first period showing trypanosomes in the blood and lymphatic glands with a normal cerebrospinal fluid ; the second in which the spinal fluid is not normal, but signs of nervous disease are not seen ; the third period characterized by nervous signs. In the present paper observations are recorded which seem to show that these periods do not always follow each other regularly, that it is hardly possible to set a time limit to them, and that chronic conditions occur in patients in apparently perfect health.

Barlovatz argues that if sleeping sickness passes regularly through various stages, one would expect to find few pathological spinal fluids in recent cases and more in old cases. In order to test the point he has made a series of lumbar and occipital punctures during routine examinations of native populations. He chose districts where regular and periodic examinations of the whole population are made, and claims that it is safe to consider that most of the patients, found for the first time to be infected at any one examination, must have fallen sick during the interval between that examination and the previous one. Diagnosis was made by finding the trypanosome in the cervical glands, and only patients who had received no treatment are considered. The results of this work are summarized in a table, in which it is seen that there are no striking differences in the distribution of the cases showing cerebrospinal fluid changes whether the previous examination took place 7 months, 2 years, 3 years earlier, or never before. Strangely enough, the figures are best for those groups where no previous examination had been made, and in which consequently there are presumably most old cases. Barlovatz comments on the fact that the proportion of third period patients seen in endemic areas never, or seldom, visited before is often strikingly low, being usually less than 3 per cent. of the total number of patients.

The results obtained from these observations suggest to the author that pathological changes in the spinal fluid may progress very slowly, and furthermore that they may appear in a patient and subsequently disappear without treatment. To test this, a number of cases of human trypanosomiasis were subject to repeated lumbar and occipital puncture before treatment was commenced, and the results are set forth in a series of graphs. These graphs, which are exceedingly interesting, show that there is no general or regular upward trend of the leucocyte and protein curves, but that both rise and fall in an irregular manner in the same patient ; the leucocyte and protein curves sometimes converge and at other times diverge. Barlovatz lays particular stress on the fact that the protein curve may rise and fall freely without treatment.

In 1927, Barlovatz made weekly lumbar punctures on third period patients who were receiving weekly doses of tryparsamide, and who, after an initial improvement, failed to profit further from the treatment ; in these cases, the cell count often showed fluctuations which could not be explained by the amount of drug given, or by changes of diet or habit, as all these factors were constant. The author considers that observations on patients whom drugs failed to sterilize are to be considered as comparable with observations on untreated cases.

Muraz and Vaisseau (1932) record that tryparsamide sometimes fails to sterilize the peripheral circulation, and yet pathological changes in the cerebrospinal fluid may disappear. Barlovatz himself has recorded observations on a series of arsenic resistant cases in about two-thirds of whom the spinal fluid was normal. An observation is recorded on a patient whose cell count dropped from 440 to 3 within a period of 10 weeks, although no treatment was given.

Barlovatz had an opportunity in 1932 of examining a group of natives who were all recognized as suffering from sleeping sickness by gland puncture in July, 1929. So far as the author could ascertain it seemed almost certain that at least 14 of the 17 patients comprising the group had never been treated. Six of the 14 were said to be dead in 1932, when Barlovatz visited the district; all the remaining 8 were in apparent health, and in only one was the spinal fluid not normal. Details regarding these cases are given in a table which is here reproduced.

Cases diagnosed July 1st, 1929, by gland puncture, and examined (except those said to be dead) in September and October, 1932.

Said to have died ...	1. Shatshoma	
	2. Muatshinana	
	3. Tshamba	
	4. Mualukengeta	
	5. Shatshikoko	
	6. Humbula	
Living. 2 injections 1930	7. Shatende	Trypanosomes in lymph nodes. 5 blood centrifugations negative. Spinal fluid quite normal. General condition good.
	8. Shahumbula	Neck glands infected. Blood centrifugation negative. Nervous. Cell-count in spinal fluid 48.
Living. 12 injections 1931	9. Kangombe	Apparently cured.
Living. No treatment	10. Mukungu	Apparently cured.
	11. Shatshikendu	Good health, no sign of disease, but during winter 1932–33 spinal leucocytosis lasting several weeks. Trypanosomes in heart blood of inoculated rabbit.
	12. N'gombe	Trypanosomes found once in centrifuged blood in Oct., 1932, but never since.
	13. Muyeketa	Neck glands negative. Blood centrifuged 14 times, trypanosomes found once. Spinal fluid normal.
	14. Tshibue	Neck glands typical, but negative 4 times. On centrifugation blood 6 times positive and 12 times negative. Spinal fluid quite normal.
	15. Masangu	Neck glands positive. Centrifuged blood twice positive and 13 times negative. Spinal fluid quite normal.
	16. Tshihuna Nama	Neck glands positive. Spinal fluid quite normal.
	17. Mukuta	Neck glands positive. Blood positive. Slight leucocytosis in spinal fluid.

In another table these 8 cases are grouped as follows :—

Cured : Mukungu.

Silent trypanosomiasis : Spinal fluid normal : N'gombe, Shatshikendu, Muyeketa, and Tshibue ; the first two of these recovered spontaneously in 1933.

Cervical glands positive. Spinal fluid normal : Masangu and Tshihuna ; spinal fluid not normal : Mukuta.

In still another table the results are recorded of weekly examinations of 7 of these patients and one other for trypanosomes by the method of triple blood centrifugation ; of the 92 triple centrifugations made only 12 were positive.

The case histories of each of these patients is then given in detail. The existence of these very protracted cases leads to the question whether they are bound to end fatally. The immediate causes of death in sleeping sickness are usually wasting and secondary infections. Wasting may be a consequence of fever or may follow upon the impaired psychic power in advanced cases. Barlovatz has examined the corpulence index in a large number of cases in various stages of the disease. The index was obtained by subtracting from the height of the patient the sum of the following circumferences.—Waist, neck, and left arm midway between the shoulder and elbow taken twice. Low numbers indicate sturdy build and high numbers slender build or wasting. A difference was found between normal and sick individuals, but it was small. No definite difference was, however, found between patients with normal spinal fluid and those with pathological spinal fluid. Barlovatz concludes that patients who have overcome the fevers which are highest at the onset of the disease, and whose nervous system remains unimpaired, need not die at all. There can be no doubt that trypanosomiasis is quite consistent with good general health.

The author concludes this very interesting paper with the following summary :—

" 1. Proportion of diseased spinal fluids in large groups of patients and degree of abnormality of these fluids bear no relation to the time presumably elapsed since infection.

" 2. Cell-count and albumen content of spinal fluid show irregular fluctuations sometimes at short intervals. Both these features may diminish without treatment and may very probably subside altogether.

" 3. Small groups of patients resistant to the drugs given, or having relapsed several times, had a high proportion of normal fluids. So had a number of patients who escaped treatment during 3½ years.

" 4. Classification of cases according to the state of the spinal fluid is rather a measure of the seriousness of the disease and a help to prognosis than a means of ascertaining the time of infection.

" 5. Possibly there is in trypanosomiasis, as in syphilis, a slight meningeal reaction shortly after infection. This reaction may disappear without developing immediately into brain and medulla localizations.

" 6. There are silent forms of human trypanosomiasis which any ordinary investigation, including inoculation into animals, fails to detect. Investigation is needed to ascertain whether such forms are likely to carry the disease into new areas.

" 7. These silent forms resemble closely what is sometimes seen after apparently successful treatment. They emphasize the part which natural resistance may play in the cure of sleeping sickness.

" 8. Human infections by *T. gambiense* may sometimes disappear spontaneously. It would seem that such a disappearance, when taking place, is a matter of years." *W. Yorke.*

FAIRBAIRN (H.). **Lange's Colloidal Gold Reaction and the Estimation of Total Proteins in the Cerebrospinal Fluid of Rhodesian Sleeping Sickness, and their Significance in Prognosis.**—*Trans. Roy. Soc. Trop. Med. & Hyg.* 1934. Mar. 12. Vol. 27. No. 5. pp. 471–490. [17 refs.]

The author made careful examinations of the cerebrospinal fluid during the course of treatment of a considerable number of cases of sleeping sickness with the object of ascertaining which of the various reactions furnish most reliable information on which to base a prognosis. Protein estimation was found most useful.

While all workers agree that treatment can be adequately controlled only by lumbar puncture, yet there is considerable evidence that the mere enumeration of cells and observations regarding the presence or absence of trypanosomes are not sufficient on which to base a prognosis. Various authors are cited in support of this contention. In following up cases one occasionally meets with very high cell counts, for which there is no obvious reason, but which cause great difficulty in prognosis. Three such examples are given. Similarly, the number of trypanosomes in the spinal fluid can fluctuate greatly. KEEVILL (1926) records a case where 750 trypanosomes were found per cmm. in the spinal fluid, and yet six days later, although there was no further treatment, only a single trypanosome was found after a prolonged search. [See KLEINE, this *Bulletin*, Vol. 28, p. 893.]

The present work was commenced in March, 1931, in the Kahama sleeping sickness area of Tanganyika, and the cases were kept under observation until July, 1933. In a very interesting series of tables the author summarizes the results of repeated examinations of the spinal fluid in a considerable number of cases during and after treatment. In these tables information is given regarding the duration of illness before treatment, the nature of the treatment, the dates of lumbar puncture, and the results of examination of the spinal fluid in respect of (1) the presence or absence of trypanosomes, (2) the cell count, (3) the amount of protein, and (4) the colloidal gold curve.

The first table shows the results of repeated lumbar puncture of 12 patients who were at the time of writing alive and well after one course of treatment. Table 2 gives similar information regarding the 12 who received more than one course of treatment, and Table 3 contains information regarding 6 patients who died.

Discussing the information supplied by these tables, Fairbairn considers that it provides an answer to the following two questions :—

(1) Why is Bayer 205 unable to cure the 25 per cent. or so of cases with a history of less than one month's illness ?

(2) How can one select those cases with a history of over one month's illness who are curable either by Bayer 205 or by a combined use of Bayer 205 and tryparsamide ?

Apparently, in some patients giving a short history, the trypanosome infection causes an early damage to the central nervous system ; this is shown by a high percentage of protein in the cerebrospinal fluid. Such cases are not curable by Bayer 205 alone, and possibly not curable at all. On the other hand, there are patients who give a history of being ill for more than one month, and yet the percentage of protein in the cerebrospinal fluid is low (indicating an intact nervous system) ; such patients are easily cured.

Fairbairn considers that the duration of the illness or the division of cases according to whether the spinal fluid has more or less than 20 cells per cmm. is only a rough clinical guide to the condition of the patient. He agrees with SICÉ that the amount of protein present in the spinal fluid is the sole basis of prognosis [see this *Bulletin*, Vol. 27, p. 820]. If at the beginning of treatment the protein is 0·03 per cent. or under, the prognosis is good and the patient can be cured (possibly by Bayer 205), but if the protein is 0·05 per cent. (and probably as low as 0·035 per cent. the prognosis is bad even with combined Bayer 205-tryparsamide treatment. In cases of doubt, *i.e.*, where the figure is between 0·03 per cent. and 0·035 per cent., the combined treatment should be used. The value of the estimation of the total protein is even more apparent in those cases with trypanosomes in the spinal fluid.

Fairbairn considers that the estimation of the cerebrospinal protein is a very great help in deciding the question whether a case is a relapse or a reinfection. Examples are given. In one case between June 3rd, 1931, when treatment stopped, and July 4th, 1933, when trypanosomes were found in both blood and spinal fluid, the cell count was between 4 and 9 cells per cmm., but the protein, 0·07 per cent. before the second course of treatment, had sunk to a trace and risen to 0·035 per cent. 9 months before the "relapse." In another case, in the 13 months between the end of treatment and the blood again showing trypanosomes, the spinal fluid protein had fallen to 0·016 per cent. and had remained there. This case is considered to be a "reinfection."

Standard of cure.—The author quotes SICÉ to the effect that it is important to continue treatment so long as the cerebrospinal fluid does not contain less than 10 cells per cmm., and 0·015 per cent. to 0·025 per cent. protein. Fairbairn draws attention to the fact that in all cases summarized in his first table the protein had returned to 0·02 per cent. or less, although there might still be as many as four cells per cmm. With the object of inquiring further into this very important matter the cases treated by Fairbairn in the Maswa District between February, 1925, and November, 1926, were re-examined. The results, which are set forth in a table, show that in only one patient was the protein over 0·03 per cent.

The colloidal gold reaction.—The author's results on this reaction support SICÉ's contention that while it is useful it has not the same value as the protein estimation. In the early stages of the disease the colloidal gold reaction is "tabetic" in type and the extent of the reaction appears to run parallel to the percentage of protein present; in the later stages of the disease, however, a general paralysis type of curve may be met with. A change from the later type to the former indicates an improvement in the clinical condition of the patient, but it would appear when once the general paralysis type of curve is found, the ultimate prognosis is hopeless, notwithstanding the fact that some immediate improvement may occur.

The following summary is given :—

"(1) The cerebrospinal fluids of a number of sleeping sickness patients (*T. rhodesiense* infection) have been tested with Lange's colloidal gold reaction, and the total proteins present estimated.

"(2) The estimation of the total protein present is the best guide to prognosis. It is also the best evidence in deciding when a patient is cured, and whether the case is one of relapse or reinfection.

"(3) The colloidal gold reaction is influenced by treatment earlier than the percentage of protein present, and is, therefore, not so useful in prognosis. In general, the reaction is 'tabetic' in type, the intensity running parallel to the amount of protein present; but when a general paralysis type of reaction is obtained, it is of grave prognostic significance."

W. Y.

Macpherson (A.). **The Critical Diagnosis of Infection by** *Trypanosoma gambiense*.—*Jl. Trop. Med. & Hyg.* 1934. Jan. 15 & Feb. 1. Vol. 37. Nos. 2 & 3. pp. 17–22; 37–43. With 23 figs. [11 refs.]

The object of the author is to depict the clinical phenomena caused by the trypanosome, excluding the phenomena resulting from the terminal meningo-encephalitis. He writes that clinical diagnosis is stated to be difficult, whilst diagnosis by laboratory methods is easy. When, however, no sleeping cases obtrude themselves to indicate the presence of the disease, it is impossible, without a critical knowledge of the clinical appearance in the early stages, to find cases upon which to practise laboratory diagnosis.

According to Macpherson the clinical evidence of the presence of trypanosomes in the body may be divided into several syndromes with, in addition, certain skin and eye symptoms. These are:—(I) Syndrome of parasites in the circulatory system; (II) Syndrome of thyroid involvement; (III) Skin symptoms; (IV) Eye symptoms; (V) Syndrome of lymphatic invasion; (VI) Psychic syndrome; (VII) Syndrome of meningo-encephalitis. These various syndromes are discussed in great detail and must be consulted in the original by those interested, as it is impossible to summarize them here.

[In the reviewer's opinion, these papers are open to much criticism. A good deal of the matter is highly speculative and not based on any sound foundation of fact; and furthermore it is very doubtful whether many of the signs and symptoms described are really the result of trypanosomiasis and not due to concurrent conditions. One or two examples might be cited. In discussing the anaemia, Macpherson writes:—

"*Anaemia.*—This is almost invariably a sign, and only noted in a thorough examination of the patient. This anaemia may be due in part to destruction of the red blood-corpuscles by the parasites, for in a fresh blood-film the red corpuscles may be seen to be attacked by the rapidly moving trypanosome, and in part the result of toxin secreted by the trypanosomes destroying the red cells. This anaemia is not a constant or a marked feature after the parasites have left the circulatory system. Cases in the late stages are seen with normal red cell counts and a high haemoglobin percentage."

The author's remarks on splenic enlargements are equally unsatisfactory. He has apparently not even contemplated the possibility that the patient might also suffer from malaria. Splenic cough is stated to be a very valuable symptom. It is a dry cough due to an impeded diaphragm, and also, possibly, a reflex irritation from the spleen.

After carefully reading these papers, the reviewer is of opinion that instead of clarifying the clinical picture of the disease, they make the task of recognizing it from clinical observations distinctly more difficult.] *W. Y.*

VAN HOOF (L.) & HENRARD (C.). La transmission cyclique de races résistantes de "Trypanosoma gambiense" par "Glossina palpalis." (Note complémentaire.) [**Cyclical Transmission of Resistant Strains of** *T. gambiense* **by** *G. palpalis.*]—*Ann. Soc. Belge de Méd. Trop.* 1934. Mar. 31. Vol. 14. No. 1. pp. 109–144. With 1 fig. [11 refs.]

The objects of the work described in this paper were, firstly to study the behaviour of strains of *T. gambiense*, obtained in various parts of the Belgian Congo, in the tsetse and in the vertebrate host, their transmissibility and sensitiveness to the usual drugs. Secondly, to re-examine the effect of a mechanical transmission to a guineapig or monkey on the cyclical transmissibility of the strains. [In a previous paper the authors stated that a strain had lost its transmissibility as the result of a single mechanical passage through a guineapig, and the reviewer had cast some doubt on the validity of this conclusion in his summary of the paper in question; this *Bulletin*, Vol. 30, p. 774.] Thirdly, to test the conservation of drug resistance through one or more cyclical developments of the strains in tsetse.

Having drawn the attention of their medical colleagues to the frequence of arsenic resistance in human trypanosomiasis, the authors had little difficulty in obtaining a number of resistant strains. Details of nine such strains are given. An attempt was made to transmit each of these strains by *G. palpalis*. The flies were fed by preference on the patient himself, but if this proved impossible they were fed on an animal inoculated from the patient.

The results of the various experiments are given in detail in a table here reproduced.

	Date of the Experiment	No. of flies dissected	No. of flies infected	% of infections	No. of infected flies living on the 10th day.		No. of infected flies living on the 15th day		Proventricular index	Salivary gland index
					prov.	total	s. g.	total		
Malanda	8.2.33–10.4.33	121	20	16·53	3	12	2	8	4·12	4·12
Kindila	8.3.33–1.5.33	101	10	10	1	8	0	7	1·25	0
Pota J.	5.4.33–30.5.33	122	15(1)	12·29	14	15	6	14	11·47	5·27
Bele Mat.	17.4.33–30.5.33	23	3	13	2	2	1(2)	2	13	6·5
Bunga S.	19.4.33–12.6.33	119	24(3)	20·17	6	17	1(2)	10	7·12	2·02
Onéma J.	27.5.33–14.7.33	136	4	3	2	4	0	3	1·5	0
Zita K.	5.6.33–8.8.33	109	19	17·43	2	15	1	7	2·32	2·49
Ibongi C.	17.7.33–18.10.33	207	12	5·8	6	12	5	12	2·4	2·4
Marçal	17.8.33–4.10.33	140	2	1·4	1	2	1	2	0·7	0·7
Kongolo L.	5.9.33–20.10.33	67	0	0	0	0	0	0	0	0

Notes.—The proventricular findings have been calculated in taking into account the infected flies living at the 10th day of the experiment, because it was on this date that we were able to observe the most recent infection of the proventriculus.

1. An intestinal infection that we estimated to be secondary to the infection of the animal to which the strain was transmitted is not taken into account.
2. Probably.
3. Two late and probably secondary intestinal infections are not taken into account.

The authors point out that certain notable differences are exhibited by the various strains in their capacity to develop in Glossina. Certain strains, such as Bunga S, give a relatively large proportion of intestinal infections as compared with a few proventricular and salivary gland infections; whilst others, such as Ibongi C strain, give a relatively

high gland infection. Still other strains, *e.g.*, Kindili, Onéma and Kongolo, were found to be non-transmissible. The authors state that whilst they do not desire to take part in the controversy regarding the significance of proventricular infections, they wish to draw attention to the fact that the index of the infection of these is equal to, or greater than, that of the salivary glands. The differences in the transmissibility index of the various strains could not be correlated with their place of origin, with their degree of drug-resistance, or with their pathogenicity for the vertebrate.

The authors next return to the point raised by them in their previous paper, viz., that the transmissibility of the strain had been lost as the result of a single passage through a guineapig. They have endeavoured to repeat this observation, but without success.

Details are then given of a series of experiments which show that the character of arsenic resistance is transmissible through several cycles in Glossina. The strain used is that from the patient Momfo Essa on which the authors conducted their earlier experiments on this subject. This patient had a normal cerebrospinal fluid, but the infection proved insensitive to repeated doses of 2 gm. of tryparsamide and also to repeated injections of 0·5 gm. of Dn 12 ; on the other hand it responded readily to Bayer 205. *G. palpalis* were infected from the patient, and the infection was transmitted to a monkey and 3 guineapigs. The monkey was used to test the sensitiveness of the strain to germanin. Guineapig 21 was given an injection of 0·15 gm. of tryparsamide without affecting the infection. It was then decided to use this animal for a second cyclical transmission, and finally it was given a dose of 0·5 gm. of tryparsamide again without results. Guineapig 22 received successively doses of 0·1 gm., 0·25 gm. per kilo of tryparsamide, and finally 0·04 gm. of Dn 12 without any action on the infection. Similarly, Guineapig 23 proved resistant to an injection of 0·02 of Dn 12.

G. palpalis were then infected from Monkey 15 and from Guineapig 21. The flies infected on Monkey 15 in turn infected Guineapig 29 and Monkey 5, and those fed on Guineapig 21 infected Guineapigs 34 and 38. Attempts to carry on the strain by cyclical transmission from Monkey 5 failed, but flies were infected from Guineapig 38 and transmitted the infection to Guineapig 49. Details regarding the reaction to various drugs on the infection in these various animals are given. The results indicate that the drug-resistance was not modified by the succession of cyclical transmissions through *G. palpalis*. It thus follows that the resistance of a trypanosome to tryparsamide is preserved intact through three successive cyclical transmissions in Glossina. The results obtained from each of the 9 strains may be summarized very briefly as follows :—

1. *Ibongi Cécile.*—A strain of little virulence in man and in monkeys and guineapigs. Transmitted cyclically to a guineapig. The trypanosome in man resisted at least 7 cgm. of tryparsamide per kilo, and in the guineapig 1 gm. of tryparsamide per kilo.

2. *Malanda.*—The trypanosome of this patient, who is an old treated case, proved to be arsenic resistant. After cyclical transmission to the guineapig, the parasite was resistant to 0·5 gm. of tryparsamide per kilo.

3. *Bele Matundu.*—In this patient the resistance of the trypanosome to tryparsamide was 0·12 gm. per kilo. After cyclical transmission the parasite resisted in the guineapig 0·5 gm. per kilo.

4. *Bunga Sakala.*—An old treated case with a slight meningeal reaction. The trypanosome resisted the usual doses of tryparsamide and 1 gm. of Bayer 205. In a mechanically infected guineapig the resistance of the

trypanosomes to tryparsamide was at least 10 cgm. per kilo. and it may well have been more, but the observations were not extended. After cyclical transmission the parasite was resistant up to 0·75 gm. of tryparsamide per kilo.

5. *Zita Kumbi.*—A recent case with a very slight meningeal reaction. The trypanosome resisted in the patient at least 0·16 gm. of tryparsamide per kilo. In guineapigs infected mechanically or cyclically the strain was resistant to doses of 0·6 gm. and 1 gm. of tryparsamide per kilo.

6. *Kindila Lisala.*—In this patient the trypanosome was resistant to the usual dose of tryparsamide, but the strain was non-transmissible with the small number of flies available.

7. *Pota Joseph.*—An old treated case with slight meningeal reaction. The trypanosomes in the patient resisted 6 to 7 cgm. of tryparsamide per kilo., and in mechanically and cyclically infected guineapigs 0·15 gm. to 0·30 gm. of the drug per kilo.

8. *Onema Joseph.*—A very old chronic case treated previously by various methods. The patient had had numerous relapses after well-ordered courses of treatment. The trypanosome was transmitted mechanically to a guineapig and then cyclically to a second guineapig. Its resistance to tryparsamide in the guineapig was very slight, *i.e.*, 0·02 gm. to 0·05 gm. per kilo.

9. *Marcal Joao.*—A resistant strain without meningeal changes. In cyclically infected guineapigs the resistance of the parasite to tryparsamide was only 0·05 gm. per kilo.

From this work the authors conclude that the three characters, (*a*) cyclical transmissibility, (*b*) resistance to tryparsamide, and (*c*) pathogenicity, vary independently of one another. The virulence of drug-resistance has been transmitted intact through Glossina.

Observations on the duration of the length of the cycle through Glossina in the Leopoldville experiments show that it is shorter than in Entebbe and probably longer than in Nigeria. Among the causes which influence the transmissibility of *T. gambiense*, the age of the infection in the vertebrate host and the nature of the pathological reactions are apparently the most important. *W. Y.*

DUKE (H. Lyndhurst). **Studies on the Factors that may influence the Transmission of the Polymorphic Trypanosomes by Tsetse. VII. *T. rhodesiense* versus *T. gambiense*: a Comparison of their Power to develop Cyclically in Glossina.**—*Ann. Trop. Med. & Parasit.* 1933. Dec. 20. Vol. 27. No. 4. pp. 569–584.

In this paper Duke has examined the power of *T. gambiense* and *T. brucei*, respectively, to develop in Glossina. The results of a long series of experiments with each trypanosome are set forth, according to the method usually adopted by Duke, in three tables. The results are summarized in the table which is reproduced on the following page.

The tables show that *T. rhodesiense* is, as a general rule, more readily transmitted by *G. palpalis* than *T. gambiense*. This is interesting, as *G. palpalis* is not the normal vector of *T. rhodesiense*. Whether this superiority will survive repeated cyclical passage through *G. palpalis* is a matter which is now under investigation. There follows a lengthy philosophical discussion on the inferences which can be drawn from this investigation, from which Duke infers that the greater adaptability of *T. rhodesiense* to tsetse suggests reflections on the origin of this trypanosome and its affinities to *T. gambiense* and *T. brucei*—reflections that lend support to the belief that *T. rhodesiense* is in reality *T. brucei* which has overcome man's resistance. The alternative explanation,

Summary of essential data in Tables I, II and III.

	T. gambiense	*T. rhodesiense*	*T. brucei*
Total no. of strains	37	21	13
No. transmissible ...	26 = 71%	21	12
No. non-transmissible	11 = 29%	0	1 = 7·6%
Average per cent. of infected flies per strain	In the 35 strains that infected tsetse = 4·4% In the 26 transmissible strains = 4·2%	6·9%	In the 12 that infected tsetse = 4·6% For strains originating from game tsetse region (7) = 4·9%
Average transmissibility index per strain	2·5	4·7	3·0 Of strains from game tsetse region (7) = 3·6
Single tests—			
Total no.	64	31	20
No. giving more than 10% of infected flies	22 = 34·3%	20 = 66%	11 = 55%
No. giving more than 15% of infected flies	9 = 15%	15 = 48%	2 = 10%
No. giving more than 20% of infected flies	5 = 8·4%	7 = 22·5%	0

viz., that *T. rhodesiense* is *T. gambiense* which has enjoyed a longer or shorter association with *G. morsitans* instead of with *G. palpalis* is also considered, and stress is laid on the need for experimental examination of this possibility. *W. Y.*

Duke (H. Lyndhurst). **Studies on the Factors that may influence the Transmission of the Polymorphic Trypanosomes by Tsetse. VIII. The Effect of Cyclical Passage through** *Glossina.*—*Ann. Trop. Med. & Parasit.* 1934. Mar. 29. Vol. 28. No. 1. pp. 79–91.

The object of the work described in this paper was to examine the effect of cyclical transmission through Glossina on the power of a trypanosome to develop in tsetse. The questions which Duke sets himself are :—

1. Does a single cyclical passage of a feebly transmissible strain through Glossina enhance the infectivity of that strain to, or its transmissibility by, tsetse ?

2. Does repeated cyclical passage through *G. palpalis* have any such effect ?

In his endeavour to answer the first question, Duke used the strain of *T. brucei* originally isolated by Hornby in Tanganyika, and subsequently sent to Duke by Corson. Corson found this strain readily transmissible by *G. morsitans* and *G. pallidipes* after 4½ years maintenance by direct passage through vertebrates. Duke's work on the transmissibility of this strain by *G. palpalis* began a few months later. Subsequently, *G. morsitans* were also used. In the following table Duke summarizes the results and tests applied to this strain with *G. palpalis* and *G. morsitans* before and after a single passage of the strain —the first for some five years—through *G. morsitans*.

		Number of flies dissected	Number containing flagellates	Percentage infected	Number of gland infections	Number of flies alive at 25th day	Number of flies alive at 30th day	Transmissibility index
G. palpalis	Before	1,501	27	1·7	1	12	6	0·1
	After	1,164	25	2·1	1	12	5	0·1
G. morsitans	Before	523	37	7·0	4	17	12	1·6
	After	291	18	6·2	0	5	4	0

As a result of this work, Duke concludes that a single cyclical passage through *G. morsitans* of a strain of *T. brucei*, which had been maintained for five years by direct inoculation from vertebrate to vertebrate, exerted no apparent effect on the power of the strain to develop in Glossina.

Details are next given of six strains which were passed cyclically through *G. palpalis*. The general conclusion drawn from this series of observations is that repeated cyclical passage of *T. brucei*, *T. rhodesiense* and *T. gambiense* through *G. palpalis* did not enhance either their infectivity to, or their transmissibility by, this species of tsetse. On the contrary, the majority of the strains so treated underwent a reduction in their power to develop in tsetse.

A certain amount of evidence has been collected which suggests that the individual vertebrate host may exert an influence on the power of a trypanosome to develop in tsetse, this effect being maintained while the trypanosome is in that individual; on removal to a new host by cyclical or direct transmission the power may be fully recovered. The schedule of one of the strains, viz., No. XXXIII *T. gambiense*, suggests that a trypanosome may remain for more than a year in one and the same vertebrate host without suffering any apparent alteration in its power of cyclical development. There are also indications in the schedules that in the calf the transmissibility of a strain undergoes reduction. *W. Y.*

Uganda Protectorate. **Annual Report of the Human Trypanosomiasis Research Institute for the Year ended 31st December, 1933** [Duke (H. Lyndhurst), Director].—11 pp. 1934. Entebbe: Govt. Printer. [Sh. 1.]

Apart from two grants for special investigations, the whole cost of maintaining the Institute fell on the Uganda Government during the year ending 31st December, 1933. The actual expenditure amounted to £4,104.

An interesting event during the year was the occurrence of direct transmission of *T. rhodesiense* from antelope to antelope by Stomoxys in the antelope quarters. Some information regarding this is given, but the observation will be fully described in a future publication.

In November, the first of what is intended to be a series of Conferences on tsetse fly and trypanosomiasis took place at Entebbe. Many matters of general interest were discussed, and the duty of investigating the prophylactic effects of Bayer 205 against human trypanosomes of man was assigned to the Institute, as was also the continuation of the program already in hand. Dr. Duke and Dr. WALLACE had been in residence during the year. Dr. WALLACE leaves the staff on his departure on leave early this year, and it is expected that Duke will return at the end of the year, after home leave, to complete the outstanding important items on the program of work. A summary of the work done during the year is given. Most of this has already been published elsewhere and received notice in this *Bulletin*.

Some seventeen strains of *T. gambiense*, *T. rhodesiense* and *T. brucei* were examined in respect of their susceptibility to human serum, their natural resistance to arsenicals, the average duration of life in animals infected with the strains and the incidence of posterior-nuclear forms. The three groups were not clear-cut in their characters, but overlapped in some respects ; for example, some of the two *rhodesiense* strains were less susceptible to atoxyl than others, and some of the *T. gambiense* strains were somewhat more resistant than the normal.

The red-cell adhesion test.—Sixty-two diagnostic tests were carried out on the sera sent to the laboratory by medical officers throughout the Protectorate. Twelve came from cases suspected clinically of trypanosomiasis and of these 3 were positive to *T. gambiense*, 2 to *T. rhodesiense*, and one doubtfully positive to *T. gambiense*. Forty-seven sera came from suspects whose glands and blood were negative and 3 from cases in whom trypanosomes had been found. The former all gave negative, and the last 3 positive, adhesion tests.

Duke has continued his study of the rôle of the antelope as the reservoir of man's trypanosomes. The first part of this study has already been published, and further valuable information will be published in the near future. During the latest stages of the investigation of the infected antelope it became necessary to have direct recourse to man. Twenty-four native volunteers offered their services ; all these volunteers were examined before being accepted. Up to the time of writing (21st January, 1934) 11 had become infected, 10 with *T. rhodesiense* and one with *T. gambiense*. In every case treatment either with Bayer 205 or tryparsamide was commenced on the day on which trypanosomes were first found in the peripheral blood ; all the patients made an uninterrupted recovery.

In this work, all attempts to infect man and animals were made by the agency of gland infected tsetse. These investigations, details of which will be ready for publication shortly, have, in Duke's opinion, established beyond all reasonable dispute that *T. rhodesiense* may lose its power of infecting man as the result of living for a time in the blood of antelope, and also, apparently, in the course of maintenance, for a year or more away from man, by cyclical passage from monkey to monkey.

A few more cases of *T. rhodesiense* infections in man were detected in the vicinity of Kampala and Masaka. The report closes with summaries of a series of papers published by Duke on the factors that may influence the transmission of the polymorphic trypanosomes by tsetse. All these have already received notice in this *Bulletin*.

W. Y.

WALLACE (J. M.). **The Polymorphic Trypanosomes of Damba Island, Victoria Nyanza. III.—Their Reactions in Laboratory Animals.**—*Ann. Trop. Med. & Parasit.* 1933. Dec. 20. Vol. 27. No. 4. pp. 553–567. [11 refs.]

This paper records further observations made on three strains of trypanosomes from wild *G. palpalis* caught on Damba Island. It deals with :—

1. The length of life of various untreated laboratory animals infected with the strains.

2. The effect of human serum on rats and mice infected with two of them.

3. The effect of atoxyl on mice infected with the same two strains.

4. The results of red-cell adhesion tests with trypanosomes and plasmas from animals infected with all three strains.

5. The presence of posterior-nuclear forms.

After recording the length of life of a number of animals infected with the three Damba strains, Wallace compares his results with those obtained by DUKE in 1912 and 1921, with strains of polymorphic trypanosomes from Damba Island. Wallace admits it is difficult to make an exact comparison, but reaches the general conclusion that the present strains appear to be more virulent than those examined in 1912 and 1921.

In a table, the author gives the results obtained by him in his experiments on the effect of normal human serum on mice infected with Strain Damba 3. The results show that in mice this strain is definitely susceptible to 1·0 cc. and to 0·5 cc. of human serum. Strains Damba 2 and Damba 3 were tested as regards their sensitiveness to normal human serum in two series of rats and the results are shown in tables. Both were susceptible to human serum, Strain 3 being rather more sensitive than Strain 2. These results are contrasted with the observations of DUKE in 1912, who found that the Situtunga strain from Damba in rats was unaffected by 1 cc. of normal human serum.

The effect of atoxyl on Strains 2 and 3 in mice was next examined. As a rule, the drug was not given until after the end of the negative period which follows the first appearance of trypanosomes in the blood. Two monkeys infected with Strain 3 were also given atoxyl. The results of these experiments are summarized in tables, and the general conclusion is reached that the strain showed an increased resistance to atoxyl as compared with that of the Damba strains isolated in 1924.

The red-cell adhesion experiment, which is described in detail, demonstrated that there is some affinity between the Damba strain and the three better known polymorphic trypanosomes, *viz.*: *T. gambiense*, *T. brucei* and *T. rhodesiense*, but it is difficult to draw any definite conclusions from this part of the work.

An examination was made of the blood of two rats and one mouse infected with Strain 3 for the presence of posterior-nuclear forms, but none was found.

In conclusion, Wallace considers that the characters of the present-day Damba trypanosomes afford some evidence in support of DUKE's hypothesis that sojourn in antelope may modify *T. gambiense* in the direction of *T. brucei*. *W. Y.*

Lester (H. M. O.). **Report on the Tsetse Investigation.**—*Nigeria Rep. on the Med. & Health Services for Year 1932.* Appendix B. pp. 85–95.

Matters discussed are—Effect on trypanosomiasis of cattle of feeding certain minerals and of tartar emetic; study of Nigerian strains of polymorphic trypanosomes; mass examination for sleeping sickness and its large scale treatment.

During the year there has been a big increase in the amount of sleeping sickness work done in the field, but laboratory research at Gadau has suffered to some extent through a further depletion of the staff. In 1930, cattle experiments were complicated by the fact that *G. morsitans* in the wet season spread throughout the cattle grazing grounds right up to the station and so infected the controls. In January of this year a complete block clearing was made for about 1,200 yards all around the station, and cattle were kept as close to the station as possible and were not allowed to graze within 500 yards of the savannah.

At the 1931 meeting of the Annual Health Committee, it was decided that experiments should be conducted at Gadau to show the effect on cattle trypanosomiasis of feeding small quantities of the following minerals: (*a*) sodium bicarbonate; (*b*) Kanwa (a native alkaline salt); (*c*) iron; (*d*) iodine; and (*e*) iron and sodium bicarbonate. The animals were given the extra minerals for a month, and then inoculated with a double infection of *T. vivax* and *T. congolense*. The disease ran a very rapid course, and within six weeks 55 of the 60 animals used had died. The mortality and course of the disease was similar in all the groups, the small doses of the minerals appearing to have no effect whatever.

Further experiments were undertaken to ascertain the effect of treating with antimony tartrate cattle infected with *T. congolense* and *T. vivax*. The results show that cattle in an advanced stage of the disease and suffering from a double infection derive little benefit from treatment with tartar emetic. Experiments were undertaken to ascertain whether *T. vivax* or *T. congolense* is of the greater economic importance in Nigeria. Ten cattle were infected with each parasite; both strains were obtained from wild *G. morsitans* and had undergone one syringe passage only. At the end of 5 months all the *T. vivax* cattle were dead and all the *T. congolense* animals were alive.

Work on the Nigerian strains of polymorphic trypanosomes has been continued. One strain, Ayu 6, isolated from an untreated case of sleeping sickness in Ayu District, where there is no great quantity of game and no *G. morsitans*, has all the characters ascribed to *T. rhodesiense*. Its virulence was similar to that of many local *T. brucei* strains, and in small animals it showed a high percentage of posterior-nuclear forms. When tested against human serum, all trypanosomes were killed within 3 hours; and it was so resistant to tryparsamide in guineapigs that a dose of about 0·30 gm. per kilo. of body weight was needed to cause the disappearance of trypanosomes from the peripheral blood. Other strains from human cases exhibited all the characteristics of classical *T. gambiense*, whilst still others seemed to occupy an intermediate position. In Lester's view these results afford strong support to the theory that *T. rhodesiense* and *T. gambiense* are really one species, and that the differentiation of African human trypanosomes into two species is artificial and unnecessary.

Observations are being carried out in an endeavour to throw some light on the vexed question of the relationship of the game trypanosome, *T. brucei*, to human trypanosomiasis. The sera of 150 persons (healthy and sick) were tested on a strain of *T. brucei*, but no case was found in which the trypanocidal power of the serum was markedly diminished. The same strain of *T. brucei* was injected subcutaneously into three European and forty African volunteers, but in every instance the result was negative.

Observations have been made which show that virulence of a trypanosome strain may be diminished very greatly by cyclical transmission through *G. tachinoides*.

There has been considerable extension of the system of mass examination of the population for sleeping sickness and of treatment of cases. At the beginning of the year, this work was in charge of two teams, but in September a third team was put into the field. Some 150,808 persons had been examined, and 13,514 cases of sleeping sickness had been diagnosed. Of these 10,620 were given a full course of 24 to 30 gm. of tryparsamide, 872 persons partial treatment, and 1,364 are still under treatment. A further 3,255 cases have been treated at general medical stations.

The position with regard to sleeping sickness in Nigeria is very disquieting, and Lester feels that we are still only touching the fringe of the matter. This year about 7,000 cases of the disease were found in the comparatively small area at the Katagum and Hadejia Survey. When the size of this small area is compared with the whole extent of the country known to be infected, the magnitude of the problem will be realized. In the Plateau Province new surveys were made in the Kaleri district, in the Doka areas of Shendam, and in the Miango and Kwall areas of Jos division; these gave total infection rates of 15·2 per cent., 11·6 per cent., and 11·6 per cent. respectively. In Lafia division, the total infection of the district surveyed was found to be 11·9 per cent., while in the towns of Lafia, Keana and Awe the infection rates were 20·3 per cent., 24·3 per cent. and 30·8 per cent., respectively.

Details are given of the work of the Sleeping Sickness Staff in the field during the year; these comprise the result of examination of the population in a large number of areas and also information regarding the number of sleeping sickness cases treated. Unfortunately, a serious accident occurred at the Kamwai treatment centre of the Pankshin division. After the second injection of tryparsamide, many of the patients became violently ill. Some sank into a state of coma and died from 3 to 7 days later; others became blind, and others recovered completely. In all, 24 patients died, and 35 became blind. As a result of this accident the majority of the infected in this area refused further treatment. The cause of this disaster is thought to be that the solution of tryparsamide was made with hot water instead of cold water. [These catastrophes, which occur from time to time in the use of tryparsamide, are very disconcerting, and it seems very important that they should be thoroughly investigated. Van den Branden has recently been examining the matter (*ante*, p. 207), but although he reached the conclusion that heating a solution of tryparsamide to 70°C., or boiling it, increases the toxicity of the drug, there is nothing in his protocols to satisfy one that the appalling toxicity of the drug in the present instance was due to this cause alone.] *W. Y.*

DE MARQUEISSAC. Prospections de maladie du sommeil effectuées au Togo de 1931 à 1933, (résultats de laboratoire). [**Laboratory Findings of S.S. Patients in Togo, 1931–33.**]—*Bull. Soc. Path. Exot.* 1934. Mar. 14. Vol. 27. No. 3. pp. 247–251.

A summary is given of the laboratory findings during examination of gland juice, blood, and spinal fluid of sleeping sickness cases in Togoland, and certain conclusions are drawn therefrom.

HÉRIVAUX and BONNET found in 1927, 1928 and 1929 in the sector of Pagouda an index of gland infection of 10, 12, and 27 per cent., respectively. In 1930, the index had fallen to 4 per cent. In 9 other villages, the most heavily infected of the whole sector, the index of puncturable glands, was 17 per cent. in 1929, and 14 per cent. in 1931 ; in the same villages the index of gland infections which was 35 per cent. in 1929, had fallen to 9 per cent. in 1933.

The blood infection in these villages appeared to have progressed whilst the gland infection was retrogressing ; *e.g.*, 81 per cent. of the cases examined in 1931 had trypanosomes only in the blood, whilst in 1929, 95 per cent. had infected glands. Data of this sort suggest that surveys not based on blood examination of all individuals may give quite fallacious results.

In April, May and June, 1933, 681 lumbar punctures were made of various groups of natives belonging to Soumdina in the sector of Pagouda. The fluids were subject to the most careful examination, *viz.* : the number and type of cells, the quantity of protein (Sicard's method) and the presence of trypanosomes. The following is a summary of the results obtained :—

A. Patients under treatment for more than 4 years and in apparently excellent condition ; no trypanosomes in blood or glands.

Number of punctures ... 120
Altered fluid ... ... 41 Index 34 per cent.

B. New patients, in good general state, non-somnolent, but with trypanosomes in blood or gland juice.

Number of punctures ... 275
Altered fluids ... ... 128 Index 46·5 per cent.

It is remarked that the changes observed in the spinal fluid of this group were limited to a hyperlymphocytosis ; no hyperalbuminosis was found.

C. Patients in whom the laboratory examinations were negative (blood and gland juice), but who showed definite clinical signs such as poor general condition or lethargy.

Number of punctures ... 158
Altered fluids ... ... 46 Index 29 per cent.

Of these 158 patients 33 were somnolent, but 9 only (27 per cent.) showed a changed spinal fluid. The remaining 125 were in poor general condition, of these 37 (29 per cent.) showed an altered spinal fluid.

The author observes that somnolence can exist without changes in the spinal fluid, but that inadequate treatment may provoke a meningeal reaction, and soon the spinal fluid may show changes. Similarly trauma, accouchement, or an intercurrent disease may cause not only signs of sleeping sickness to appear, but also changes in the spinal fluid in latent cases of the disease. Finally, in occasional instances lumbar puncture itself may provoke a meningeal reaction.

Spinal puncture is essential if one is to decide whether patients who have been under treatment for several years are cured. Moreover, it constitutes an indispensable method of diagnosis, as it alone will

enable the physician to pick out gravely affected patients amongst apparently healthy persons, and it will also give valuable information regarding the type of virus. Hyperlymphocytosis and hyperalbuminosis each has its own significance. A hyperlymphocytosis, especially of the small and medium sized mononuclears, without an excess of protein, indicates a benign virus; whilst a hyperlymphocytosis marked by the presence of large mononuclears, mulberry cells and plasma cells, accompanied by an excess of protein, indicates the presence of a severe virus necessitating special treatment. For the former type the author recommends two series a year of a dozen weekly injections of orsanine, and for the latter repeated series of moranyl-tryparsamide. *W. Y.*

Barrett (R. E.). **Notes on the Epidemiology of Sleeping Sickness with Special Reference to Conditions in the West Nile District of Uganda.**—*East African Med. Jl.* 1934. Apr. Vol. 11. No. 1. pp. 20–28.

This paper, which was read at the Meeting of the British Medical Association at Dar-es-Salaam in January, 1934, consists of generalizations on sleeping sickness as it is found in the West Nile District of Uganda. *W. Y.*

Berny (P.). Deux cas de récidive dans la maladie du sommeil. [**Two Cases of Second Attack in S.S.**]—*Bull. Soc. Path. Exot.* 1934. Mar. 14. Vol. 27. No. 3. pp. 251–253.

Details are given of two patients who suffered from a second attack of trypanosomiasis 15 and 8 years respectively after the initial attack. In the periods between the attacks the patients have been carefully examined at regular intervals and there seems no reason to doubt but that they were cured of their initial infections. *W. Y.*

Pales (Léon). Les surprises de l'autopsie chez quelques trypanosomés. [**The Surprises of the Autopsy in Trypanosomiasis.**]—*Bull. Soc. Path. Exot.* 1934. Feb. 14. Vol. 27. No. 2. pp. 162–167. With 1 fig.

After asking the question: From what do sleeping sickness patients die? Pales gives an account of the findings at post-mortems in six cases of this disease.

From the protocols, which are given in full, it appears that in the first case there was pronounced tuberculosis of the urinary system, in the second haemorrhagic perisplenitis, in the third a ruptured aneurysm of the descending thoracic aorta, in the fourth an enormously enlarged malignant liver and spleen, in the fifth a trypanosomal meningitis, and finally in the sixth severe icterus.

The author states that if these patients had died in the bush they would certainly have been recorded as sleeping sickness deaths. He recalls that the Report of the Pasteur Institute of Brazzaville (1931) has emphasized the fact that little is known concerning the real cause of death in patients who have once been recognized as infected with trypanosomes. There seems to be no doubt that intercurrent conditions are frequently overlooked and consequently the mortality due to sleeping sickness itself is usually over-estimated. Systematic post-mortem examinations would no doubt decrease the number of deaths now ascribed to sleeping sickness.

In conclusion, the author asks whether there can be any relation between trypanosomiasis and the various conditions found at the post-mortem examination of his six cases. For example: Aneurysm of the aorta is found in syphilitics, can it also result from trypanosomiasis? Had the severe icterus anything to do with the trypanosomiasis with which the patient had been treated? Does arsenical treatment hasten the evolution of cancer of the liver?

These are interesting questions, but it is impossible to answer them.

W. Y.

Moustardier (G.), Sicé (A.), Mercier (H.) & Varneau. Trypanosomiase humaine latente. [**Latent Human Trypanosomiasis.**]—*Bull. Soc. Path. Exot.* 1934. Apr. 11. Vol. 27. No. 4. pp. 318–321.

This note gives clinical details of a case of human trypanosomiasis in which the infection lay dormant for a prolonged period. The patient was a native of Haute-Volta. He left Africa on the 27th July, 1931, 4½ months after enlistment, and was sent to La Rochelle, where he arrived on the 9th August, 1931. Apart from indisposition, the result of a sprain, for 21 days during 1932, and an attack of influenza of three weeks' duration at the beginning of 1933, the patient remained in good health. On the 7th September, 1933, he visited a doctor owing to pain in the left side. The doctor noticed definitely enlarged subclavicular glands, and puncture revealed the presence of trypanosomes. No other sign or symptom of the disease was observed.

This case is interesting as the patient had served for 29 months in France, and his service had only been interrupted for a few days on the two occasions mentioned above. *W. Y.*

van den Branden (F.) & Appelmans (M.). Les troubles visuels dans la trypanosomiase humaine. [**Visual Troubles in Human Trypanosomiasis.**]—*Ann. Soc. Belge de Méd. Trop.* 1934. Mar. 31. Vol. 14. No. 1. pp. 91–107. [20 refs.]

In this paper the authors deal with the incidence and causes of visual troubles met with in human trypanosomiasis.

The authors lay stress on the relative rarity of visual troubles encountered amongst patients in whom the disease has evolved naturally, compared with their relative frequence in treated patients. This is an interesting fact in view of the close relationship of the eyes with the nervous system, of which the retina and optic nerve are merely embryological and anatomical outgrowths. In sleeping sickness, diplopia, paralytic strabismus, and the Argyll-Robertson pupil have not been noted. Only rarely are lesions found in the depth of the eye. Morax observed only uveitis. Of 418 sleeping sickness patients seen by Roy, only 3 exhibited lesions in the eye, and these consisted of oedema of the papilla; and Thiroux and d'Anfreville observed 4 similar cases. Van Hoof has observed optic atrophy in patients who had never been treated. Van den Branden remarks that this absence of ocular symptoms in sleeping sickness is surprising when one calls to mind their frequence in neurosyphilis, in tubercular meningitis, and in acute meningococcal meningitis.

One of the greatest dangers in the treatment of patients in the second stage of sleeping sickness is undoubtedly damaged sight. A

very interesting table is given summarizing observations made on 118 cases in the second stage of sleeping sickness. All the cases were diagnosed by the discovery of trypanosomes either in the gland juice or in the blood. The table shows in each case the weight of the patient before treatment, the pressure of the spinal fluid and its protein and cell content, the total quantity of tryparsamide injected in weekly doses of 2 gm., and, finally, the date of appearance of visual disturbance during treatment. It is remarked that visual disturbances appear suddenly after a variable number of weekly injections of 2 gm. of tryparsamide, and that they are often noticed early in the course of treatment. In the present series of 118 cases the sight was infected in no less than 24 patients. This high percentage is, however, not always obtained, as in another group of 69 patients only 5·8 per cent. developed visual disturbance. The ocular troubles are grave; they are manifest regularly in both eyes and often lead to blindness if arsenical treatment be continued. If, however, treatment is interrupted in time, the vision improves and visual acuity may be recovered in great part. Among the authors' patients suffering from ocular complications, reduction of the field of vision to at least $\frac{1}{10}$th of the normal has been noted, certain patients have become completely blind, others have retained a perception of light, whilst others have been able to count fingers 2 to 3 metres from each eye.

The authors greatly regret that ophthalmoscopic examination of the eyes was not made in their patients. They point out, however, that this has its limitations. The papilla may be very pale as the result, for example, of vascular spasm produced by acute quinine poisoning without damage to the fibres and without loss of vision. Conversely, the vision can be greatly reduced, or even abolished, and the papilla retain its normal appearance, provided the lesions are retrobulbar. What is important is to examine the visual acuity and visual field before the commencement of treatment, and to make sure that there is no change during treatment.

The authors then turn to the question of what causes optic neuritis. They consider in detail three theories. Firstly, that it is due to an excess pressure of the cerebrospinal fluid resulting in stasis of the papillary vessels; secondly, that it is the result of an arsenical intoxication of the optic nerve; and, thirdly, that the toxic neuritis is due to the trypanosomes themselves. Each of these theories is thoroughly examined, and each is in turn dismissed as inadequate to explain the phenomenon. They then advance what they describe as a mixed theory, *viz.*, that the ocular disturbance is due to two different factors, a trypanocidal substance and the trypanosome infected region (*terrain trypanosomé*). It is the arsenicals which are reputed to be neurotropic that are the most efficacious in the treatment of the second stage of sleeping sickness, and it is for this very reason that tryparsamide is at the same time so valuable a drug and so dangerous for the optic nerve; but knowledge on this subject is purely conjectural. Little is known regarding the distribution of metallic arsenic in the different organs, and still less is known regarding the tropism of the arsenicals. We do not know why certain arsenicals containing the same amount of arsenic fail to produce the same visual disturbance. With regard to the second factor, *viz.*, the trypanosome infected region, statistics show that the ocular troubles are especially common in those patients in whom the cerebrospinal fluid is most changed. Among the 118 cases mentioned in this paper

70 had more than 50 lymphocytes per cmm. in the cerebrospinal fluid, and 48 had less than 50. Of the former, 21 exhibited visual trouble, and of the latter only 3. There appears then to be a relationship between the gravity of the changes in the cerebrospinal fluid and the frequency of visual trouble.

Summing up their theory, the authors state that the sheath of the optic nerve is a prolongation of the meninges; invasion hence spreads easily from one to the other, giving rise to an optic meningitis. It is not astonishing that this optic meningitis remains latent, because cerebrospinal meningitis itself usually evolves without clinical signs. Optic neuritis, then, has a mixed origin: involvement of the sheaths, and feeble resistance of the nerve fibres to endotoxins liberated during treatment, and to the arsenicals themselves. The visual troubles are complicated by the formation of fibrous tissue if the lesions are in the tissues of the nerves and of its sheaths.

The article concludes by pointing out the advantages of tryparsamide over atoxyl from the point of view of ocular complications. The chief advantage of the former drug appears to be that if treatment is stopped immediately there is any interference with the acuity of vision, resolution occurs and the sight is recovered, whereas atoxyl often leads to irremediable ocular damage. *W. Y.*

Assoreira (Manuel José). Tratamento da doença do sono pelas injecções intra-arteriais de triparsamida. [**Intra-arterial Injection of Tryparsamide in Sleeping Sickness.**]—Reprinted from *Med. Contemporanea*. 1934. Feb. 11. Vol. 52. No. 6. pp. 50–53.

In making trial of this form of treatment the author had in view two groups of patients: one, those with ocular symptoms; the other, those who in spite of subcutaneous injections of the drug presented still an abnormal cerebrospinal fluid. He states that he will need some 4–5 months more to complete his study and in this paper records details of five patients belonging to the first group. The drug is injected into the common carotid a little below the level of the hyoid.

In one patient the lesions were of long standing and improvement, though present, was slower than in the other four. The details of one may be given as an example:—

A man of 35 years, seen on 16th June, 1931, complaining of headache, drowsiness, weakness and fever. He had some anaemia, was wasted, and had enlarged cervical glands in the juice of which trypanosomes were found. He received 6 injections, altogether 12 gm., of tryparsamide at weekly intervals when visual disturbances arose; treatment was stopped and the patient disappeared till March 1933. At that time he was anaemic, with slight oedema of face and trunk, a vacant, somnolent aspect and with amblyopia. He could see nothing at a distance and near objects were "as if in a thick fog." Subcutaneous injections totalling 16 gm. were given in the next 7 weeks without bringing about any improvement. He then received 2 gm. into the carotid artery. The following day he said he could see better and on the next could distinguish objects perfectly, even at a distance. On the third day he was able to thread a needle. Treatment was persevered with and the improvement was maintained.

In the others the improvement was equally striking and the author states that "in patients with slight lesions of long standing or with severe but recent symptoms, the results of this method of treatment are surprising and are seen as early as the day after the injection. With serious lesions of long standing the action is more delayed, and

the effects may not be noticed till 8 days later, and after a second injection, but are nevertheless, quite obvious." (See this *Bulletin*, Vol. 30, p. 783.) *H. H. S.*

Mora (Damas). L'emploi de la voie intracarotidienne dans le traitement des périodes avancées de la maladie du sommeil. L'action de la tryparsamide, injectée dans la carotide sur les troubles visuels des trypanosomés. [**Treatment of Advanced Cases of S.S. by the Intracarotid Route. Tryparsamide and Visual Disturbances.**] —*Ann. Soc. Belge de Méd. Trop.* 1934. Mar. 31. Vol. 14. No. 1. pp. 25–48.

The technique of the intracarotid administration of tryparsamide and other drugs is described, and a summary of the results obtained in certain late cases of sleeping sickness is given.

Preliminary experiments were performed on dogs, into the carotid of which mercurochrome, urotropine, tryparsamide, Bayer 205, and atoxyl were injected. The results of this work suggest that the toxic action of these drugs is not greater when given by the intracarotid route than when given intravenously. Mercurochrome, however, should not be injected into the carotid because it produces dangerous lesions of the central nervous system. Urotropine can apparently be given with safety, as can also Bayer 205. Tryparsamide is tolerated by dogs when given into the carotid in very high doses, and is distinctly less dangerous than atoxyl.

The author then turned his attention to man. In the earliest cases the carotid was exposed before injection, but later a technique was developed whereby it was found that injections could easily be made without exposing the vessel.

The patient is placed on his back on a table with the head lying naturally; if he is in an excited state it is advisable to give an injection of morphia. The face is turned to the side opposite to that of the artery chosen for injection. The doctor always stands on the right side of the patient and feels with the left index finger for the common carotid at the level of the lower border of the larynx and at the anterior border of the sterno-mastoid. The artery is fixed by the finger against the transverse processes of the cervical vertebrae, or sometimes preferably against the trachea. It is remarked that this is particularly easy in sleeping sickness, because the patients are usually emaciated. After having fixed the artery, the needle is introduced perpendicularly to the surface of the skin along the edge of the finger holding the artery. The needle should be thin, but not too fine, and provided with a short bevel. After piercing the skin it is pushed in slowly in the direction of the artery, until the pulsations of the artery are felt against it, indicating that the tip of the needle is in contact with the wall of the artery. A slight pressure now suffices to penetrate the wall of the vessel, and jets of arterial blood show that the needle is actually in the artery and not in the vein. The sensation of piercing the muscular wall of an artery is moreover so different from that of piercing a vein that a little experience will leave one in no doubt on the matter. The syringe is then attached to the needle and the drug injected slowly into the artery.

It is found that one can inject as much as 3·5 gm. of tryparsamide into a patient of 55 kilograms without any untoward symptoms.

Details concerning the results of treatment of a number of advanced cases of sleeping sickness by this method are then given. The author claims as the result of his experience that the method gives most valuable results. The central nervous system is greatly ameliorated.

The technique is so simple that it can be practised in the bush. Three injections seem to suffice for the production of great amelioration or even apparent cure. The intracarotid route seems to reach certain retreats of the trypanosomes, which are otherwise inaccessible.

The author then passes to a consideration of the action of tryparsamide given by the intracarotid method on patients suffering from visual troubles. A number of observations are recorded on sleeping sickness patients with ocular trouble in whom intracarotid injections of tryparsamide produced rapid and quite unexpected improvement of vision. As the result of his work in this direction, the author concludes that the intracarotid injection of tryparsamide seems to be most useful in the treatment of ocular troubles which manifest themselves in the course of sleeping sickness, provided that hopeless destruction of the nerve tissue has not occurred before treatment. Work is being continued along these lines. *W. Y.*

Sicé (A.). Conception actuelle du traitement de la méningo-encéphalite trypanosomique. [**Present-day Notions of Treatment of the Nervous Stage of Trypanosomiasis.**]—*Marseille-Méd.* 1933. Sept. 5. Vol. 70. No. 25. pp. 253–261.

In this article the author lays down certain general rules for the guidance of those called upon to treat sleeping sickness.

It is easy to-day with the aid of orsanine [Fourneau 270] to cure quickly 98 per cent. of cases of human trypanosomiasis, provided the central nervous system is intact ; and it is also easy to cure early nervous cases with orsanine or tryparsamide, but the treatment is more prolonged. A single therapeutic agent well given—tryparsamide—suffices to ameliorate the troubles in nervous trypanosomiasis and to effect cure in 78 per cent. of cases. But it must be remembered that tryparsamide is a poor trypanocidal substance, and that notwithstanding its powerful action on the cerebrospinal lesions, it may fail to prevent the reappearance of trypanosomes in the blood. In such cases it is necessary to give other (non-arsenical) preparations, particularly germanin or moranyl.

The author lays great stress on the importance of forming a correct estimate of the state in which a patient is at the time of treatment. He emphasizes once again the value of the information which can be obtained from lumbar puncture. He has already drawn attention to the fact that in trypanosomiasis the nervous system may become involved much more early than was formerly thought possible ; in support of this contention he gives details of a case which has recently come under his care. *W. Y.*

Sicé (A.), Cousin (E.) & Dantec. Recherche de l'arsenic dans le liquide céphalo-rachidien des trypanosomés traités par la tryparsamide. [**Arsenic Content of the Cerebrospinal Fluid of Patients treated with Tryparsamide.**]—*Bull. Soc. Path. Exot.* 1933. Dec. 13. Vol. 26. No. 10. pp. 1263–1265.

Examinations were made for the presence of arsenic in the cerebrospinal fluid of natives suffering from the nervous stage of sleeping sickness and who had received varying amounts of tryparsamide. The spinal punctures were performed 6 to 72 hours after the last of a series of intravenous injections of tryparsamide ; the last dose was apparently in each case 1 gm.

The 1st group of patients were given a course of 25 gm. of tryparsamide, and the spinal fluid was collected 6 hours after the last injection. The 2nd group were also given 25 gm. of the drug, but spinal puncture was performed 24 hours after the last dose. In the spinal fluid of both these groups the presence of arsenic was detected, but in amounts too small to estimate. Similar results were obtained in a 3rd group who had received 32–35 gm. of tryparsamide and in whom spinal puncture was performed 30 hours after the last dose.

No trace of arsenic was discovered in the spinal fluid of a 4th group of patients who had been given 53 gm. of tryparsamide, and in whom spinal puncture was performed 48 hours after the last injection; nor in the fluid of a 5th group collected 72 hours after the last dose of a course of 72 gm.

Apparently the presence of arsenic in the spinal fluid is very transient and the drug can be detected only within the first 24 hours following an intravenous injection of 1 gm. *W. Y.*

VAN DEN BRANDEN (F.) & DUMONT (P.). Contribution à l'étude de la stabilité de la glyphenarsine (tryparsamide). [**Study of the Stability of Tryparsamide.**]—*Ann. Soc. Belge de Méd. Trop.* 1933. Dec. 31. Vol. 13. No. 4. pp. 451–454.

The question of the stability of tryparsamide is considered, and, in particular, whether the drug changes as the result of exposure to a moist atmosphere over prolonged periods.

The changes which are found to take place in "914" have given rise to some uneasiness in respect of tryparsamide. The authors, however, are satisfied that there is no need for anxiety on this score. Tryparsamide is a stable compound and its composition is well defined; different samples from the same source are similar as are also samples from various sources. The rose colouration which is sometimes seen is not due to a change in the drug itself, but to changes in impurities in the drug. It is not possible to increase the density of the colouration by exposing the drug for longer periods to various atmospheric conditions.

A quantity of tryparsamide, which had remained unchanged for 2 years, was placed for 3 months in a petri dish inside an incubator at 37°C., the atmosphere of which was kept saturated. At the end of this time there was a distinct yellow colour, but examination of the drug showed that all its properties—physical, chemical and therapeutic—were unchanged, and that the only alteration was a slight increase in toxicity [see also this *Bulletin*, Vol. 30, pp. 786 & 787].

W. Y.

SPYROU. Trypanosés-arsénorésistants et fortes doses de tryponarsyl. [**Arsenic-Resistant Patients and Strong Doses of Tryponarsyl.**]—*Ann. Soc. Belge de Méd. Trop.* 1933. Dec. 31. Vol. 13. No. 4. pp. 435–446. With 1 map.

Details are given of the results obtained in the treatment of arsenic-resistant cases of sleeping sickness with various doses of tryponarsyl.

The observations were made in the Tshela-Est district, which is situated near the centre of the Mayumbe Belge. The disease is distributed throughout the district and is of special interest in view of the fact that for some time it has been resistant to arsenicals. The

author defines arsenic resistance as a state in which trypanosomes persist in the peripheral blood and glands, notwithstanding adequate arsenical treatment. Two groups of resistant cases are met with—a first in which the trypanosomes are resistant to the first course of treatment, and a second in which the initial treatment causes their disappearance, but relapse soon occurs.

The first cases of arsenic-resistance in Tshela-Est were found in 1929, and since then they have become ever more numerous until in certain places they now form 55·2 per cent. of the total cases. The results of treating with tryponarsyl a number of resistant cases are given in detail. The first series consisted of 8 patients previously treated with small doses of tryponarsyl (0·03 gm. to 0·047 gm. per kilo.); these patients were given large doses of the drug, but the infection remained uninfluenced in all cases.

The second series consisted of previously untreated cases and they were given large doses of the drug. The results were distinctly better; in 7 of the 11 patients the peripheral blood and glands were sterilized, but in 4 the infection proved to be completely resistant. *W. Y.*

VAN HOOF (L.). Un nouveau dérivé antimonie organique, le Dn 18, dans la trypanosomiase humaine. [**A New Organic Antimonial Derivative, Dn 18, in Human Trypanosomiasis.**]—*Ann. Soc. Belge de Méd. Trop.* 1933. Dec. 31. Vol. 13. No. 4. pp. 479–493.

The therapeutic value of the new antimonial preparation Dn 18 of the Union Chimique Belge has been tested on a number of cases of sleeping sickness. It is considered to be a valuable remedy.

This preparation is a complex trivalent compound [this *Bulletin*, vol. 30, p. 788, and vol. 31, p. 210]. Solutions can be kept for at least 24 hours, but they must not be sterilized by heating. It is important to note that for the injections glass syringes with platinum or nickel needles must be used, as steel causes changes in the drug; they can be given intravenously, intramuscularly, or subcutaneously, as the substance is non-irritating.

A single intravenous injection of 0·5 gm. produced peripheral sterilization as determined by gland puncture, or triple centrifugation of blood, within probably about 7 minutes, but in all cases relapses occur after periods varying from 7 to 72 days. In determining the dosage which can be safely used in man, the author began with intravenous injections of 0·25 gm. and 0·5 gm. and advanced cautiously up to 0·75 gm. This seemed to be the limit, because although it was well tolerated by some cases, in others it produced nausea, vomiting and syncope. No intolerance was observed in patients who were given a series of injections of 0·5 gm. twice weekly. The drug appeared to be non-cumulative and the toxic dermatitis seen after the use of Dn 12 was not observed with Dn 18. As much as 10 gm. could be given in this way without producing the least trouble.

The results of treating a number of cases are set forth in detail. The patients are divided up into small groups according to whether they were treated with Dn alone, whether they had previously been given other drugs, or whether Dn was given in association with other drugs. In two cases the drug was given intrathecally, and finally it was tested on two patients who had proved resistant to tryparsamide.

Summarizing the general results obtained, it appears that Dn 18 is remarkable for the speed with which it produced peripheral sterilization (7 minutes) and for the length of the periods of sterilization

produced by a single dose, *viz.*, 7 to 72 days. It has constant and uniform trypanocidal activity which is not exhibited by Dn 7, Dn 9, or Dn 12. The tissues of the host exhibit great tolerance to the drug, and apparently it has a non-cumulative action, so that prolonged and intensive courses can be given without toxic results. It has a definite curative value in advanced cases of the disease; this is shown by modifications in the cytological and chemical changes of the spinal fluid and by clinical improvement of the patients.

It is of great value when used in association with other trypanocidal substances. In respect of this, however, the author writes that, notwithstanding some very good results obtained by mixed treatment of germanin, tryponarsyl and Dn 18, he does not recommend the adoption of this mode of treatment as a general rule.

Experience of the treatment of large numbers of cases at Leopoldville has shown a much greater frequence of optic atrophy as the result of tryparsamide plus germanin than from tryparsamide alone. The author considers that germanin in large doses has an irritative action on the meninges; this is shown by an increase of lymphocytes and by the appearance of large mononuclears, and by a notable increase in the amount of protein in the cerebrospinal fluid. It is quite possible that this explains the increase of sensitiveness of the optic nerve to arsenicals.

Finally, the efficacy of Dn 18 in typical cases of arsenic resistance makes the drug a valuable remedy in these difficult forms of the disease.

W. Y.

Smythe (C. V.) & Reiner (L.). **Toxic Effect of Sodium Monoiodoacetate on Trypanosomes.**—*Proc. Soc. Experim. Biol. & Med.* 1933. Nov. Vol. 31. No. 2. pp. 289–292. [15 refs.]

The authors have studied the trypanocidal action of sodium monoiodoacetate both *in vitro* and *in vivo*.

In vitro experiments showed that a 0·001 M solution killed *T. equiperdum* in from 2 to 3 minutes. Preliminary experiments on 14 rats showed that the maximum tolerated dose of sodium iodoacetate injected intravenously into a normal 240 gm. rat is 0·2 cc. of a 0·25 M solution. Subcutaneous and intramuscular injections gave approximately the same results. When this dose was injected into a rat infected with *T. equiperdum*, the blood became free from trypanosomes within 2 to 3 hours. A number of the infected animals died sometimes after the trypanosomes had disappeared from the blood. This suggested to the authors that the infected animals were somewhat more sensitive to the drug than normal rats. The blood remained free from trypanosomes for from 2 to 10 days. A second dose cleared the blood for about the same length of time, and the treatment has up to date been repeated seven times and the animals are apparently in good health, with the exception of some inflammation and soreness at the place of injection.

The authors remark that there are differences in the action of iodoacetate and of arsenicals. Thus, the action of the former could not be prevented either *in vitro* or *in vivo* by the addition of sulfhydryl in the form of cystein or thiosulphate solution, whereas arsenicals were detoxified in analogous experiments. Further experiments showed that an arsenic resistant strain of trypanosomes is just as sensitive to iodoacetate as is the normal strain. *W. Y.*

Moncorps (C.) & Bohnstedt (R. M.). Ueber den Einfluss des reduzierten Glutathion auf die kurative Neosalvarsanwirkung bei der naganakranken Maus. [**The Influence of Reduced Glutathione on the Curative Action of Salvarsan in Nagana Infected Mice.**]—*Arch. f. Dermat. u. Syph.* 1934. Apr. 20. Vol. 170. No. 1. pp. 26–32. With 3 figs.

In this investigation the authors have inquired whether glutathione has any action on trypanosomes *in vitro*, whether it influences the course of nagana infection in mice, and finally whether it in any way interferes with the result of treating nagana-infected mice with salvarsan. As the result of their experiments they found :—

1. That in nagana infected mice the incubation period was shortened, and death occurred more quickly, when the infected blood was mixed with glutathione before injection.
2. That the previous treatment of a trypanosome suspension with a mixture of glutathione and salvarsan produced a more rapid infection than did a suspension of trypanosomes treated only with salvarsan.
3. *In vitro* the motility of the trypanosomes was lengthened by the addition of glutathione, and the inhibitory action of salvarsan was destroyed by it.
4. In nagana-infected mice the trypanocidal action of neosalvarsan was sometimes increased and sometimes inhibited by the simultaneous administration of glutathione, according to the quantity given and to the method of its administration. *W. Y.*

Hawking (Frank). **The Absorption of Acriflavine by Trypanosomes.** —*Ann. Trop. Med. & Parasit.* 1934. Mar. 29. Vol. 28. No. 1. pp. 67–77. [10 refs.]

The author has examined the capacity of normal and atoxyl resistant strains of *T. rhodesiense* to absorb acriflavine. This drug was chosen because its chemotherapeutic actions *in vitro* and *in vivo* closely resemble those of trivalent arsenicals, and because the brilliant green fluorescence, which it exhibits in dilute solution, promised a simple method of quantitative estimation.

This investigation was inspired by the previous work of Yorke, Murgatroyd and Hawking (this *Bulletin*, Vol. 28, p. 910), who showed that whereas a normal strain of trypanosomes rapidly absorbs a trivalent arsenical compound, an atoxyl resistant strain fails to absorb any appreciable quantity of the drug. This observation is of considerable academic importance in that whilst it is in harmony with Ehrlich's explanation of the mechanism of drug resistance, it appears to render untenable the hypothesis of Voegtlin, Dyer and Miller.

Hawking's experiments, which are given in detail, show that when normal trypanosomes are suspended in a solution of acriflavine they absorb practically the whole of the drug from the medium ; and from the deposit of trypanosomes it is possible to extract measurable quantities of the drug. When, however, atoxyl resistant trypanosomes are exposed to similar concentrations of the drug, they remove only small quantities from the medium.

Experiments show that the absorption of acriflavine by normal trypanosomes occurs very rapidly both at 37°C. and 16°C. Information is also supplied regarding the maximum quantity of acriflavine which can be absorbed by a given number of trypanosomes.

Somewhat comparable observations were made on infected mice. These show that if mice heavily infected with the normal strain are

injected with acriflavine and killed by exsanguination half an hour later, measurable amounts of the drug can be extracted from the trypanosomes. In similar experiments with mice infected with the atoxyl resistant strain no appreciable amount of acriflavine could be so extracted. *W. Y.*

Steudel (Emil). Wie bewährt sich Bayer 205 als Heilmittel gegen die Schlafkrankheit? [**The Curative Value of Bayer 205 in S.S.**] —*Muench. Med. Woch.* 1933. Dec. 22. Vol. 80. No. 51. pp. 2009–2011.

Steudel summarizes the various publications which have hitherto appeared relating to the value of Bayer 205 in the treatment of sleeping sickness. All these papers have already received notice in this *Bulletin*. *W. Y.*

Corson (J. F.). **A Further Note on the Action of Normal Human Blood-Serum on** *Trypanosoma rhodesiense* **in Relation to Cyclical Passage through Tsetse Flies.**—*Jl. Trop. Med. & Hyg.* 1933. Dec. 15. Vol. 36. No. 24. pp. 378–379.

The experiment described in this paper was performed with the object of ascertaining whether increased susceptibility to human serum in a strain of *T. rhodesiense* was transmitted through tsetse flies.

A number of white rats and four guineapigs were infected by inoculation with the blood of a patient suffering from a recent infection of *T. rhodesiense*. Laboratory-bred *G. morsitans* were fed on the guineapigs, and the infection cyclically transmitted to white rats. The rats infected by inoculation from the patient's blood, and those infected from the guineapigs by the flies were injected with normal human serum. The results are given in a table, which shows that the increased susceptibility to human serum caused by passage of the strain through guineapigs was transmitted by *Glossina*, unless, as is possible, it was acquired in the flies. *W. Y.*

Corson (J. F.). **Direct and Cyclical Transmission of** *Trypanosoma rhodesiense* **through Guinea-Pigs. A Comparison of the Reaction to Normal Human Serum.**—*Jl. Trop. Med. & Hyg.* 1934. Apr. 16. Vol. 37. No. 8. pp. 113–114.

Although it has not been proved by experiment, and perhaps cannot be proved, it seems very probable that the trypanocidal action of normal human blood serum or plasma, is also a property of the circulating blood of man and plays some part in his resistance to infection with trypanosomes. Consequently, it is of considerable interest to know whether the reaction to human serum of *T. rhodesiense* in lower animals is affected by cyclical transmission.

Adams [this *Bulletin*, vol. 30, p. 768] and Fairbairn [*tom. cit.*, p. 767] using *in vitro* technique, have shown that in recently isolated strains of *T. rhodesiense* the proportion of resistant trypanosomes decreases in the course of successive mechanical transmissions through small laboratory animals; and the former found that in guineapigs a definite loss of resistance occurred in three strains of *T. rhodesiense* after a single cyclical transmission by tsetse flies (*G. palpalis*). On the other hand, experiments *in vivo* with rats and guineapigs by the

author [*ante*, p. 201] indicated that cyclical passage through *G. morsitans* did not restore resistance to human serum that had been diminished by direct passages.

Corson, in his present work, inoculated a guineapig with the blood of an infected man and carried on one branch of this strain through guineapigs by direct inoculation, and the other by cyclically infected fly as is shown in the following scheme :—

$$\text{Man} - \text{G.P.95} = \text{Fly} = \text{G.P.124} - \text{G.P.142} \begin{cases} = \text{Fly} = \text{G.P.172} = \\ \quad \text{Fly} = \text{G.P.195} \\ - \text{G.P.158} - \text{G.P.187} \end{cases}$$

24.7.33.

On 19th January, 1934, 15 rats were inoculated from Guineapig 195 of the fly transmission series and 15 rats from Guineapig 187 of the direct transmission series. The weight of each of these rats was about 90 gm., and when their peripheral blood showed a moderate infection of 10–50 trypanosomes per microscope field, each was inoculated subcutaneously with 2 cc. of normal human serum. The results, which are set out in a table, suggest that, so far as man's resistance to infection with *T. rhodesiense* may depend on the trypanocidal action of his blood, he would not be less resistant to infection with trypanosomes transmitted cyclically from animal to animal for a given period, than if the passages were by mechanical transmission.

W. Y.

Corson (J. F.). **Infection of the Cerebro-spinal Fluid of an Antelope with** *Trypanosoma rhodesiense*.—*Ann. Trop. Med. & Parasit.* 1934. Mar. 29. Vol. 28. No. 1. p. 141.

Laboratory-bred *G. morsitans* were infected from a guineapig inoculated from the blood of a Rhodesian sleeping sickness patient, and the salivary glands of two infected flies were inoculated into a dik-dik. Two months later the dik-dik died and a few minutes after death the cerebrospinal fluid, free from red blood corpuscles, was obtained by suboccipital puncture. There were 4 trypanosomes and 400 leucocytes per cubic millimetre of fluid. The blood of the dik-dik contained numerous trypanosomes, and post-mortem examination showed no cause for death. Corson adds that this antelope is very susceptible to infection with *T. rhodesiense*, but it is not yet known whether the infection is always followed by death within a period of time which would indicate that the infection was the cause of death.

W. Y.

Corson (J. F.). **Latent Infection of** *Trypanosoma brucei* **in a White Rat.**—*Jl. Trop. Med. & Hyg.* 1934. Jan. 1. Vol. 37. No. 1. pp. 11–12.

After referring to the fact that Thomson and Robertson (1926) had shown that *T. gambiense* inoculated from man into rats may cause a latent infection of at least six months' duration, and that a similar latent or chronic infection of *T. rhodesiense* may follow the treatment of an infected rat with a single dose of tryparsamide, Corson gives details of an example of latent infection in one of a number of white rats infected by him with a strain of *T. brucei* obtained from a Zululand donkey.

The rat in question was inoculated from a dog on October 13, 1932. Its blood was examined frequently between this date and March 21,

1933, but no trypanosomes were discovered. In February, 1933, it had a litter of young, none of which was infected, and again in June, 1933, it gave birth to a single young one. On June 24th, the animal was noticed to be ill, and the blood was found to be swarming with trypanosomes morphologically identical with *T. brucei*. The rat died 254 days after inoculation. Corson notes that accidental infection of the animal can be excluded.

Details of a large number of rats inoculated with this strain are given in a table, from which it is seen that the parasite had an unusually low virulence for white rats. Several rats in fact failed to become infected, as did also guineapigs inoculated with the strain. The strain was, however, infective for dogs and rabbits. On October 5, 1932, four European volunteers were inoculated subcutaneously with the blood of a dog which contained numerous trypanosomes at the time; they have shown no signs or symptoms of the infection.

W. Y.

Corson (J. F.). **A Further Note on a Strain of *Trypanosoma brucei* from Zululand.**—*Jl. Trop. Med. & Hyg.* 1934. May 15. Vol. 37. No. 10. pp. 152–153.

This paper records further observations on the strain of *T. brucei* from Zululand. In his previous paper, Corson had drawn attention to the fact that infected rats live, in the earlier passages, usually for periods of from 60 to 200 days, and that in the case of one rat the infection remained latent for no less than 9 months. Six rats subinoculated from the blood of this rat shortly before its death all became infected and died in from 13 to 19 days. This increased virulence was maintained in subsequent direct passages in rats, thus clearly marking off this branch of the strain from the rest and giving a picture similar to that of a virulent strain of *T. rhodesiense*. Guineapigs could now also be infected. The strain had previously failed to infect them. As it has been suggested that cyclical passage modifies polymorphic trypanosomes by stabilizing their virulence or removing acquired characters, it was decided to pass the strain through *G. morsitans* and to observe whether this passage affected the recently acquired virulence. Laboratory-bred *G. morsitans* were fed on a guineapig which had been inoculated from an infected rat of the virulent branch of the strain. Two infected flies were isolated; one was fed on the author, and subsequently on a series of rats, and the other infected fly was fed on rats. The author did not become infected, but all the rats did, and all developed an acute infection. Apparently, therefore no loss of virulence occurred as the result of cyclical passage.

W. Y.

Konné (M.) & Pieraerts (G.). Obtention, à partir d'un *Trypanosoma rhodesiense* polymorphe, d'une souche sans noyau postérieur. [**Loss of Posterior Nuclear Forms in a Strain of *T. rhodesiense*.**]—*Bull. Soc. Path. Exot.* 1933. Dec. 13. Vol. 26. No. 10. pp. 1261–1263.

Both of the two guineapigs in which a strain *Brucei-pecaudi* was being maintained were found dead one morning; in an attempt to

recover the strain a number of mice were injected with the blood obtained from the lungs and heart. After a prolonged incubation period of three weeks one of the mice was found to be infected. The curious fact was observed that, although the original strain was pronouncedly polymorphic, many of the short forms exhibiting a posterior nucleus, the recovered strain no longer exhibited this polymorphism.

An attempt was then made to repeat this observation on a strain of *T. rhodesiense* recently isolated from man. This attempt failed, and the authors then decided to try the effect of infecting rats with single trypanosomes by means of Oehler's capillary tube method. In the first two series of experiments, comprising respectively 10 and 15 rats, none of the animals became infected, but in the third 2 of 10 rats became infected. One of these developed the usual polymorphic type of infection, but the other developed an infection in which it was impossible to discover posterior-nuclear forms. Subinoculations of the latter strain through a series of 15 rats likewise failed to produce posterior-nuclear trypanosomes. Generally speaking, the long forms considerably predominated, only a few medium and short forms being seen. Attempts to make this strain polymorphic again and to cause the reappearance of posterior-nuclear forms, by administering small doses of Bayer or tryparsamide, and by transferring the strain into guineapigs, failed.

In an attempt to explain the phenomenon, the authors remark that it is well known that strains of *T. rhodesiense* passaged through laboratory animals tend gradually to lose their posterior-nuclear forms. They suggest that certain individuals lose their power to produce these forms long before others do so, and that their strain had arisen from such a trypanosome. *W. Y.*

Culbertson (James T.). **The Trypanocidal Action of Human Serum: the Relationship between the Trypanocidal Action of the Serum and Man's Immunity to the Trypanosomes Pathogenic for Animals.** —*Ann. Trop. Med. & Parasit.* 1934. Mar. 29. Vol. 28. No. 1. pp. 93–97. [12 refs.]

The object of the work described in this paper was to ascertain the effect of human serum upon infections in rats with *T. lewisi* in an effort to relate the trypanocidal activity of human serum to man's immunity to the trypanosomes which infect animals.

The results of the experiments, which are summarized in a table, furnish no evidence that human serum when injected into rats in doses of 3 cc. exerts a prophylactic effect upon the *T. lewisi* infections. The first attempts to demonstrate the therapeutic effect of the serum upon *T. lewisi* were made at a time when the parasites were in a stage of rapid multiplication; the serum had no effect upon the parasites, which continued to multiply. The results of the second attempt are, however, less clear cut, since one rat was free from parasites one day after the injection of serum, but it seems probable that this was a *post hoc* and not a *propter hoc* phenomenon. These experiments, in the author's opinion, provide additional evidence that man's immunity to the species of trypanosomes, which naturally infect animals, is based on factors other than the trypanocidal activity of the human serum.

W. Y.

Schilling (Claus), assisted by the late H. Schreck, H. Neumann & H. Kunert. **Immunization against Trypanosomiasis.**—*Jl. Trop. Med. & Hyg.* 1934. Mar. 1. Vol. 37. No. 5. pp. 70–72.

The paper is substantially the same as two papers previously published by these authors [*ante*, p. 213]. Experiments on the two foals "Zeus" and "Lottchen" are again described in detail.

Another line of work described in the present paper was to transmit extremely few trypanosomes from an animal carrying a labile infection with the object of producing the same infection in a calf. That this is possible has been demonstrated in a foal and six calves. In the latter animals the infection may be so feeble that the trypanosomes cannot be found in the blood and the temperature does not rise above 40°C.; nevertheless, after 57 days the presence of trypanocidal antibodies could be demonstrated in the blood. In the case of the foal "Erna," which was inoculated with 5 cc. of the blood of the foal "Lottchen," containing extremely few trypanosomes, the temperature became irregular for a few days only. The weight rose from 65 to 140 kg., but trypanosomes were nearly always present in the blood. Five months later (Sept., 1932) this foal was bitten by *G. morsitans* infected with *T. congolense* and *T. brucei*. Although a week later both parasites were demonstrable, only *T. brucei* continued to multiply. The animal was subsequently treated with antimosan.

In the author's opinion, the inoculation of this foal with "Lottchen's" blood had set up a labile infection which prevented *T. congolense* developing when these were inoculated by flies. *W. Y.*

Raffel (Sidney). **Studies in Immunity to Trypanosomes. I. Acquired Immunity in *Trypanosoma equiperdum* Infected Rats. The Rieckenberg Reaction.**—*Amer. Jl. Hyg.* 1934. Mar. Vol. 19. No. 2. pp. 416–448. With 1 diagram & 3 graphs. [43 refs.]

This paper is the first of a series recording the results of investigations carried out on the immunology of trypanosome infections in the rat.

It opens with a somewhat lengthy summary of the work of previous investigators on the subject. As a result of his examination of the literature, the author points out that immunity reactions are so exceedingly delicate that they distinguish between different strains of the same parasite and are consequently of no value for the identification of trypanosome species. In support of this he quotes the well-known observation of Hartmann (1930), who isolated 3 relapse strains of *T. brucei* by means of rabbit inoculations. He then injected the original strain into the scrota of normal rabbits and superinfected at other points with the relapse strains. Primary chancres were obtained at all the sites of inoculation; whereas if superinfection was done with the original strain the animals developed no chancres at the points of superinfection [see this *Bulletin*, Vol. 27, p. 851].

The author commenced his investigations by studying experimental infections of *T. equiperdum* in the rat. When these animals were infected with large numbers of trypanosomes the disease ran an acute course and the rats died in 4 or 5 days. When, however, small infective doses were given, relapsing types of infections were obtained. Details of these experiments are given in a table. The development of immune bodies in these infections was studied, as was also the development

of the "Rieckenberg" antibodies, which were elaborated at the trypanocidal crises. Among other points of interest brought out by these infections was the fact that these antibodies were found present in a fraction of the blood other than the fibrinogen to which they have been previously ascribed. The author gives the following summary of his work :—

"1. With ordinary heavy infective doses of *Trypanosoma equiperdum* in rats an acute blood infection is obtained, with death occurring in from three to seven days after infection. The length of life is dependent upon the size of the infective dose, and probably to some extent on the weight of the animal employed.

"2. With small infective doses of organisms the rat may show an immunity to the parasites. Immunity occurs in the majority of animals given these small numbers of organisms, and antibodies may be produced several times during the course of an infection. The invariable result, however, is a fatal relapse. This finding is contrary to the results reported by previous investigators, who have described the infection with virulent *T. equiperdum* in this animal as always being acute in nature.

"(*a*) Immunity may be produced to the original infecting strain before organisms have appeared in the blood stream at all in microscopically demonstrable numbers. Antibodies may also be formed during the periods following visible crises against the relapse strain resulting from such a crisis.

"(*b*) The immunity is strictly strain specific.

"(*c*) The first relapse strains of the same original strain are the same in different rats.

"3. Subinfective doses of living trypanosomes do not cause the production of immunity in this animal. Since the parasites comprising subinfective doses are most probably killed by the natural resistance powers of the host very soon after introduction into the body, the conclusion is drawn that immunity to trypanosomes in this animal is dependent upon the presence of living parasites, even if only as a latent infection.

"4. Investigation of the Rieckenberg or "thrombocytobarin" antibody has revealed it to be associated with the globulin fraction of the serum. Previous reports have for the most part assigned this antibody to the fibrinogen of the plasma.

"(*a*) The antibody may be demonstrated in this fraction by the addition of non-specific particulate elements, such as bacterial vaccines or the normal whole bloods of various animals, to the test.

"(*b*) In view of the fact that the antibody is found in association with the same protein of the blood as other known antibodies, it is suggested that from the viewpoint of the essential identity of antibodies, this one is only one manifestation of the fundamental immunity response of the host to the parasites." *W. Y.*

Schwetz (J.). L'influence de la splénectomie sur l'évolution des trypanosomes pathogènes (*Tr. gambiense* et *Tr. congolense*) chez les rats et les souris. [**Influence of Splenectomy on the Development of Pathogenic Trypanosomes in Rats and Mice.**]—*Bull. Soc. Path. Exot.* 1934. Mar. 14. Vol. 27. No. 3. pp. 253–260.

Experiments were undertaken to ascertain the effect of splenectomy on trypanosomal infections in rats and mice.

It was found that splenectomy did not render the rodents susceptible to infection with *T. vivax*. Similarly, splenectomy exercised little

effect on the susceptibility of these animals to *T. gambiense*, but as a rule its effect on their susceptibility to *T. congolense* was more pronounced. *W. Y.*

ARNAUD. Procédé nouveau de culture de "Trypanosoma gambiense" sur milieux artificiels. [**New Method of culturing** *T. gambiense*.]—*Ann. Soc. Belge de Méd. Trop.* 1934. Mar. 31. Vol. 14. No. 1. p. 1.

Recently PAGNIEZ (1932) has drawn attention to the curious properties of human and ox serum treated for two minutes with ether. The author has inquired whether this procedure will not remove from human serum its property of inhibiting the growth *in vitro* of *T. gambiense*.

A quantity of human serum was shaken for two minutes with an equal volume of ether, and after allowing the fluids to separate by standing, the serum was removed and mixed with twice its volume of Ringer-Locke solution, and sterilized by filtration. Flasks containing 50 cc. of this medium were then inoculated with 10 or 12 drops of the blood of a guineapig heavily infected with trypanosomes. In 4 to 12 days a good culture was obtained, and this was easily carried on by subinoculation. *W. Y.*

VAN HOOF (L.). Immunité et guérison spontanée de singes cercopithèques infectés par *Trypanosoma gambiense*. [**Immunity and Spontaneous Cure of Cercopithecus Monkeys infected with** *T. gambiense*.]—*Bull. Soc. Path. Exot.* 1934. Feb. 14. Vol. 27. No. 2. pp. 167–169.

Spontaneous cure is apparently rare in human trypanosomiasis; the author has encountered only a single instance of this, and DYLEFF has reported a few others. [Some years ago the reviewer searched the literature for records of such cases, and the result of his efforts are summarized in this *Bulletin*, Vol. 18, p. 155.] During his work on the transmission of drug resistant trypanosomes van Hoof encountered a number of cases of spontaneous cure and immunity in his experimental monkeys. Details of three such cases are given.

Monkey XX was injected on 20 March, 1933, with the salivary gland of a tsetse heavily infected with trypanosomes resistant to tryparsamide. The fly had been infected on a patient, and the trypanosome resisted in guineapigs at least 0·5 gm. of tryparsamide per kilo. The monkey showed trypanosomes for the first time on 29 March and its blood remained positive until 12 June, 1933. Trypanosomes then disappeared and were not found afterwards. The animal remained in good health until the end of August, when it died of dysentery. At the post-mortem no evidence of trypanosomiasis was found.

Monkey I was inoculated on 14 Jan., 1932, with arsenic resistant trypanosomes (*T. gambiense*) from a guineapig. Its blood became positive on 29 Jan., and was thereafter irregularly positive until 1 March, 1932, when trypanosomes were found for the last time. The animal was kept under constant observation until 24 April, 1933, and so far as could be ascertained was free from infection. In order to see if it were immune massive injections of resistant trypanosomes were injected on 24 April, 9 June, 3 July and 17 July, 1933. The animal proved to be absolutely refractory.

Other similar cases have been observed by the author. *W. Y.*

Kunert (Herbert) & Kunzmann (Theo). Die Beziehungen zwischen Trypanosomeninfektion und Blutrhodangehalt. [**The Relationship between Trypanosome Infection and the Blood Sulphocyanate Content.**]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1934. Apr. Vol. 38. No. 4. pp. 159–170. [17 refs.]

Estimations of the sulphocyanate content have been made on the blood of a series of animals at various stages of trypanosomal infections.

The occurrence of sulphocyanate in the human and animal body has been recognized for a long time, and the phenomenon has been studied both in health and in disease. A summary of this work is given. Through the work of Sullivan and Dawson (1921) and others we know that sulphocyanate is formed during the metabolism of proteins, and that this is due to the action of a ferment, Rhodanese. It is believed that sulphocyanate must be a regular constituent of the body.

In their own experimental work the authors used the colorimetric method first described by Lockemann and Ulrich (1931) for the estimation of sulphocyanate in the gastric juice. Preliminary investigations showed the amount of sulphocyanate in the blood of normal horses and goats to vary from 0·05 to 0·5 millinormal (= 0·29 mgm. per cent. and 2·9 mgm. per cent.) and of calves and dogs from 0·005 mn. to 0·05 mn. (= 0·029 mgm. per cent. and 0·29 mgm. per cent.). The result of estimation of the sulphocyanate blood content in a series of these animals infected with *T. congolense* and *T. brucei* is given in a number of tables. It was found that these infections in all the animals produced a rise in the sulphocyanate blood content. This increase is the expression of an increased destruction of protein due to the trypanosomal infection. The sulphocyanate blood content is independent of the temperature and of the intensity of the blood infection, and it is not influenced by adrenalin. It varies during the course of the infection and may fall to very low values shortly before death. Similarly it falls to normal after the animal is definitely cured, but after an incomplete cure the fall is merely transient. In such cases a subsequent rise of the sulphocyanate titre signifies a relapse of the infection even though this may not be manifest from blood examination. *W. Y.*

Penso (Giuseppe). Sul ciclo di sviluppo del "Trypanosoma gambiense" negli ospiti vertebrati. [**The Developmental Cycle of *Trypanosoma gambiense* in the Vertebrate Host.**]—*Ann. di Med. Nav. e Colon.* 1934. Jan.–Feb. 40th Year. Vol. 1. No. 1–2. pp. 25–77. With 6 text figs. & 43 figs. (3 coloured) on 11 plates. [54 refs.]

The author states that there are obscurities and lacunae in our knowledge of the development of trypanosomes in the vertebrate hosts, and the investigation, the details of which are described in this article, was undertaken to clarify the former and fill in the latter. His article is of much interest and importance to all those studying the question.*

The "anomalous forms" described by many workers have been interpreted as involutionary rather than evolutionary, and denominated "polymorphism" whereas the author would regard them as stages

*A number of Dr. Penso's figures are reproduced because the *Annali* are not readily accessible to many of our readers.

in the cycle of development. He maintains that if these forms occur not only in the same species of animal but also in one individual animal, and that under unchanged conditions of environment, nutrition, temperature, etc., the term "polymorphism" has practically no biological significance.

The author's researches were carried out with a strain of *T. gambiense* obtained from the Public Health Laboratory of Italy and for experimental purposes he employed guineapigs, rabbits and white rats, injecting them first intraperitoneally and later intravenously with blood taken from the heart of infected animals. The changes in and

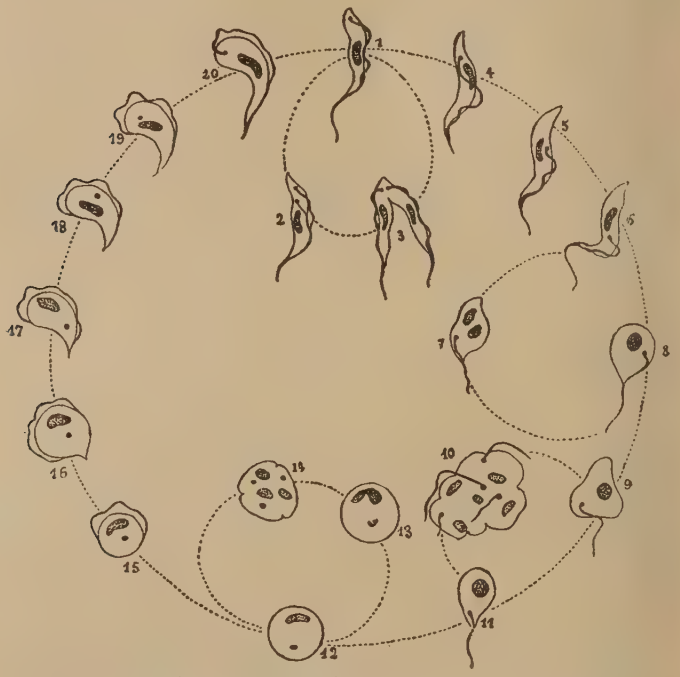

Fig. 1. Developmental cycle of *T. gambiense* in vertebrate host.

1. Classical form of *T. gambiense*.
2 & 3. Classical forms undergoing binary fission.
4 & 5. Evolutionary forms evolving towards crithidial phase.
6. Crithidial form.
7. Crithidial form undergoing binary fission.
8. Crithidial form evolving towards leptomonad phase.
9. Leptomonad form (early stage).
10. Leptomonad form in multiple fission (rosette form).
11. Leptomonad form (typical).
12. Leishmanial form.
13. Leishmanial form in binary fission.
14. Leishmanial form in multiple fission.
15. Post-leishmanial form.
16. Tadpole form (initial stage).
17. Tadpole form with anterior blepharoblast.
18. Tadpole form with blepharoblast above nucleus.
19. Tadpole form with posterior blepharoblast.
20. Pre-trypanosome form.

development stages of the parasite were studied by a series of smears of the peripheral blood and of the various organs and by histological examination of tissues fixed in Schaudinn's or Bouin's fluid immediately after the death of the animal.

In the first series he details the results in 11 guineapigs, 4 rabbits and 5 rats—the first twenty animals he dealt with—but the actual number used was 137. Detailed measurement of the trypanosomes seen in the peripheral blood at frequent intervals are presented in tabular form.

In another series he studied the morphological changes of the trypanosome occurring after injection of trypanocidal substances.

Then follows a detailed discussion of the findings. The author states that after inoculation the trypanosomes undergo typical morphological modifications, *succeeding one another and not seeming to appear casually* [the italics are the reviewer's], but occurring in a definite sequence and repeatable experimentally. Each of these is described in the letterpress, but the cycle as reproduced (Figs. 1 & 2) will demonstrate the main changes, and save lengthy description.

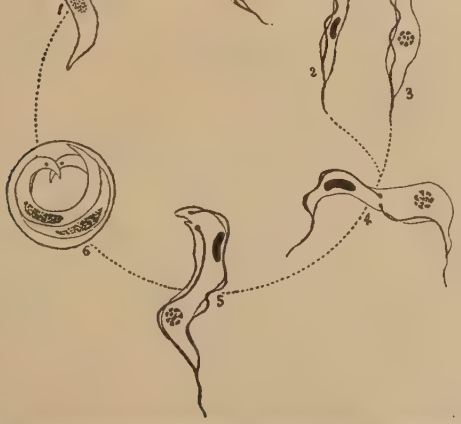

Fig. 2. Probable sexual cycle of *T. gambiense* in vertebrate host.

1. Classical form of *T. gambiense* (undifferentiated).
2. Type A form (probably female).
3. Type B form (probably male).

4 & 5. Successive stages of syngamy.

6. *Endotrypanum* (endoglobular phase).
7. *Endotrypanum* form (free phase).

A few words will, however, make the author's explanation of these clearer. He states the trypanosome forms as being of two types; the most noteworthy difference for our purpose (other differences are given in the text) is in the nucleus which in Type A is curved and elongated, "banana-shaped," but in Type B is spherical with large chromatin bodies mostly disposed marginally (see Fig. 3). These

two types he regards as sexual forms, not as evolutionary stages of one form and he illustrates them, and in fact all the stages, both by microphotographs, which are numerous and on the whole well reproduced, and by diagrammatic sketches. Some show the two types in union (Fig 4), according to Dr. Penso in copulation, and not, as some have interpreted the picture, as trypanosomes dividing.

Fig. 3.—(*a*) Nucleus of trypanosome of Type A.
(*b*) Nucleus of trypanosome of Type B.

Fig. 4. Trypanosomes of Type A and B in union.
[Reproduced from *Annali di Medicina Navale e Coloniale.*]

The next stage is the *Endotrypanum* form, differing mainly in the structure and position of the blepharoplast (as in *T. cruzi*); then follow *Crithidial* forms evolving to *Leptomonad* and later to *Leishmanial* forms. Soon after the disappearance of the parasite from the general circulation—the so-called "trypanolytic crisis"—special structures are to be found in the bone marrow and elsewhere, small Leishmania-like forms with a small undulating membrane having one or two undulations only, immediately posterior to the macronucleus; this increases in size and is called the *post-leishmania* form. Others are seen in which the protoplasm anterior to the blepharoplast is drawn out to a fine undulating membrane, and the parasite as a whole comes to resemble a "comma with an enlarged head"; this he denominates the *tadpole form* (forme a girino). Lastly, by migration of the blepharoplast in a posterior direction the *pre-trypanosome form* results, after which all that is needed for it to become a typical trypanosome is a more marked development of the flagellum and the undulating membrane.

Above is a sketch of the two types [sexual, according to the author's view] in conjugation, and another of the probable cycle of sexual development. All the stages sketched, and many others, are represented in the series of microphotographs appended to the article.

H. H. S.

Bourguignon (G. C.). Arsénorésistance trypanosomique et corps latents. [**Arsenic-Resistant Trypanosomes and Latent Bodies.**]—*Ann. Soc. Belge de Méd. Trop.* 1934. Mar. 31. Vol. 14. No. 1. pp. 19–23.

Although the majority of authors consider the "latent bodies," seen in certain organs and more rarely in the blood, as involution forms, others have advanced various hypotheses regarding the significance of these bodies. One of these theories is that it is such forms that are responsible for the development of an arsenic-resistant race of trypanosomes in animals which have been treated with atoxyl or tryparsamide.

With the object of examining this theory it occurred to Bourguignon that it would be interesting to ascertain whether a strain of *T. gambiense* strongly resistant to arsenicals would not, under the influence of arsenical treatment, liberate into the peripheral blood latent bodies capable of carrying on the resistant strain. Experiments of this kind performed on 7 guineapigs and 3 monkeys failed to afford any support for the hypothesis. *W. Y.*

Zottner (G.). Possibilité d'obtention d'un antigène alcoolique stable pour le diagnostic des trypanosomiases animales par déviation du complément. [**A Stable Alcoholic Antigen for the Diagnosis of Animal Trypanosomiasis by Complement Deviation.**]—*C. R. Soc. Biol.* 1934. Vol. 115. No. 1. pp. 19–20.

The diagnosis of animal trypanosomiasis by complement deviation has been the subject of much work, but up to the present only one antigen, that of Watson, has given good results. Watson's antigen consists of trypanosomes, freshly obtained, carefully washed and preserved on ice in a glycerin-formalin mixture; it has a high antigenic value and a low anticomplementary power, but it has the great disadvantage that it cannot be kept for more than a few days. Zottner has consequently attempted to prepare an antigen as specific as Watson's, but more stable. After many efforts he believes he has at last succeeded in obtaining a stable alcoholic antigen, which gives as good results a year after preparation as it did immediately it was made.

Rats infected with *T. equiperdum* or *T. marocanum* are bled at the height of the infection into 1·5 per cent. sodium citrate solution. The mixture is centrifuged slowly in a hand machine until the red corpuscles are sedimented. The plasma containing the trypanosomes is then removed and centrifuged at high speed to throw down the trypanosomes. The white or rosy deposit consisting almost entirely of trypanosomes with a few red cells is then washed thrice, the first time in distilled water to lyse the red cells, and the remaining two times in physiological saline. After the third washing the supernatant fluid is removed as completely as possible from the deposit, to which is added acetone. After a final centrifugation the deposit of trypanosomes is placed in an incubator for the evaporation of the acetone. The dry deposit of trypanosomes is then ground up in a mortar with a few drops of absolute alcohol, and finally a suspension is made consisting of 1 cgm. of dry trypanosomes in 10 cc. of absolute alcohol. The suspension is placed in hermetically sealed bottles of coloured glass and kept at 40°C. for 15 days; each day the bottles are thoroughly shaken. This completes the preparation of the antigen.

For use the alcohol is evaporated in a watch-glass and physiological saline is slowly added drop by drop so as to obtain a uniform suspension. The liquid thus obtained should be faintly opalescent. The volume of the saline suspension should be 5 times that of the alcoholic suspension.

According to the author the antigen thus prepared is stable and can be used for the diagnosis of trypanosomiasis by the method of complement deviation. *W. Y.*

POINDEXTER (Hildrus A.). **Observations on the Defense Mechanism in *Trypanosoma equiperdum* and *Trypanosoma lewisi* Infections in Guinea Pigs and Rats.**—*Amer. Jl. Trop. Med.* 1933. Nov. Vol. 13. No. 6. pp. 555–575. [16 refs.]

The injection of sugar into the peritoneal cavity of guineapigs producing an artificial hyperglycaemia favours the rate of reproduction of *Trypanosoma equiperdum* in the blood to such an extent that the incubation period after inoculation is shortened and death supervenes two or three weeks earlier than in control animals. Injection of pilocarpin also shortens the incubation period and increases the number of trypanosomes in the blood of an infected animal, but this is due merely to contraction of the spleen, which is the most important organ of the reticulo-endothelial system in the defence against infection. Infection at first stimulates the haematopoietic organs, as indicated by a temporary increase in the red cells, an increase which is lost when haemolytic activity manifests itself. Infection in the pregnant guineapig is milder, though the offspring suffer. Towards the end of an infection there is a reduction in the number of trypanosomes associated with a destruction of red blood corpuscles producing an anoxaemia which is largely responsible for the death of the animal. There is a significant decrease in the resistance of the red blood corpuscles as contrasted with a *T. lewisi* infection in which there is none. The change in size of the spleen of rats infected with *T. lewisi* is parallel to the change in guineapigs infected with *T. equiperdum*. An increase in the monocytes and platelets of the blood runs parallel with the increase in the size of the spleen in *T. lewisi* infections. Rats recovered from *T. lewisi* infection live longer when infected with *T. equiperdum* than control animals. *C. M. Wenyon.*

WHITNALL (A. B. M.). **The Trypanosome Infections of *Glossina pallidipes* in the Umfolosi Game Reserve, Zululand. (Final Report.)**—*Onderstepoort Jl. Vet. Sci. & Animal Industry.* Pretoria. 1934. Jan. Vol. 2. No. 1. pp. 7–21. With 1 fig.

This report deals with the results of dissection of wild *G. pallidipes* during the period October, 1932, to June, 1933; and a comparison is made with those recorded in the last report [see this *Bulletin*, Vol. 30, p. 457]. Attempts were made to follow the possible effect of a reduction in the fly population by means of traps upon the trypanosome infections of the tsetse. The flies dissected were all caught in the "Harris" trap, in either the Sijembeni (A.5.) or Dengeza (B.4.) sections of the game reserve.

The total number of flies examined in the present work was 1,129 compared with 1,606 examined the previous year. A summary of the results obtained at re-examination is given in a table. The percentage of flies infected appears to have increased from 3·42 to 5·14. This increase affects both sexes. The males of the two observations have respectively 3·31 per cent. infected and 6·87 per cent., and the females 3·46 per cent. and 4·45 per cent. There was an increase in the case of each species of trypanosome. *T. vivax* was still the predominating infection and represented 39·7 per cent. of the total infections. *T. congolense* came next, forming 36·2 per cent. of the infections, and *T. brucei* last, with 12·1 per cent. The percentage of mixed infections appears to have slightly decreased. The author states that in assessing the significance of these results consideration must be given to external factors, *e.g.*, trapping of the flies has been carried on continuously in eastern sections of the reserve and has greatly reduced the fly population ; in the western sections trapping was abandoned from December, 1931.

Game and its movements is also a factor which must have a great influence on the trypanosome infections of the fly, and, unfortunately, this factor cannot be accurately recorded even by continuous observations. In comparing the infections found in the two Sections A.5 and B.4, the author notes that there was considerable variation in the local conditions. Section B.4 was in the abandoned area, and consequently fly conditions were returning gradually to normal. Section A.5 was in the area of continuous operation and conditions regarding fly density were abnormal owing to intensive trapping. The fly density in Section B was great, while in Section A.5 it was very low. The results of proboscis examinations of flies caught in these two localities are given in tables. The percentage of flies infected varies considerably. The author states that it is remarkable that these variations have occurred in localities about 5 miles apart ; they suggest amongst other things that the flies do not pass with any regularity from one focus to another. The analysis of the results presented in the two tables indicates further that the infectivity varies in one locality from month to month.

In another table, the author gives figures showing the possible effect of reducing the fly population by trapping upon the trypanosome infections. The general inference from this work is that, as the fly population becomes less dense, the percentage of flies infected has increased ; the increase has occurred in the number of males infected.

Whilst engaged on fly dissection a peculiar anomaly in the glands and hypopharynx of *G. pallidipes* was noted. Among 1,129 flies examined, 32 (2·8 per cent.) showed a distinct thickening of the salivary glands, and in each case where the salivary glands were thickened the hypopharynx was degenerated. The glands may be swollen to more than four times their normal thickness and show convolutions without signs of infection. In these cases, the hypopharynx is broad and stumpy, being approximately three or four times the normal breadth and sometimes less than $\frac{1}{10}$th of the normal length. The fact that mature infections of *T. brucei* have been found in such flies indicates that they can feed and live for at least three weeks. Seven infections have been found in the 32 cases of this anomaly ; three of the proboscis group (*T. vivax*) ; one of the proboscis and gut group (*T. congolense*), and three of the proboscis gut and salivary gland group (*T. brucei*). In no case, however, were trypanosomes seen in the degenerated hypo-

pharynx, and the question arises whether such flies are capable of transmitting infection. After considering this matter, the author concludes that in these cases *T. brucei* could probably be transmitted, but not *T. vivax* or *T. congolense.*

In conclusion, details are given of a severe outbreak of nagana in the winter of 1932, where it seemed probable that Stomoxys transmitted the infection. *W. Y.*

VAN HOOF (L.) & HENRARD (C.). Recherches sur les trypanosomes pathogènes du bétail à Léopoldville (Congo Belge). [**The Pathogenic Trypanosomes of Live-Stock at Leopoldville.**]—*Ann. Soc. Belge de Méd. Trop.* 1933. Dec. 31. Vol. 13. No. 4. pp. 495–516. [11 refs.]

Since the beginning of 1932, the authors have been impressed during their dissection of wild tsetses by the number of flies infected with trypanosomes pathogenic to domestic animals. They pointed out to the Administration that this was probably the explanation of their failure to rear stock, and with a view to throwing further light on the matter they decided to examine (1) the natural index of infection of Glossina in the neighbourhood of Leopoldville, where game and stock are equally rare, and (2) the same index in districts where the density of Glossina was great and where infected animals were present.

This work has enabled the authors firstly, to assess the gravity of animal trypanosomiasis in the district investigated and the efficacy of certain drugs, and secondly, to discover polymorphic trypanosomes of animals and trypanosomes pathogenic to man.

A number of wild *G. palpalis* were caught in three districts in the neighbourhood of Leopoldsville. Dissection showed that the flies were infected with *T. congolense* and *T. grayi.* The infection rate with the former trypanosome varied from 0·7 per cent. to more than 4 per cent., according to the abundance of the vertebrate reservoir in the district. In a second series of experiments, 1,345 *G. palpalis* were caught and fed on 11 goats, an antelope (*Tragelaphus spekei*) and 5 guineapigs. All the goats became infected, 3 with *T. congolense*, 1 with *T. vivax*, and 7 with a double infection of *T. congolense* and *T. vivax* ; the antelope also became infected with both *T. congolense* and *T. vivax* ; 3 of the 5 guineapigs became infected with a large polymorphic trypanosome (*T. pecaudi-brucei* ?) and the other two with a mixed infection of this trypanosome and *T. congolense.* Details are given of the evolution of these infections in a large number of animals, chiefly goats, and the effect of treatment upon them.

The next portion of the report deals with the endemicity of trypanosomiasis in goats and pigs indigenous to the Lower Congo. A single blood film from a considerable number of these animals was examined from different localities. The results show that *T. congolense* was by far the most important trypanosome. *T. vivax* was found on only a single occasion. In two other tables the results of treatment of animals infected with *T. congolense* and *T. vivax* respectively are summarized. The drugs used were Dn12, Dn.18, Dn. 20, Bayer 204, tryparosan, tartar emetic, and mixtures of Bayer 205 and the Dn compounds. The results obtained were only moderate, but the temporary sterilizing effect of Dn compounds is interesting. *W. Y.*

Kunert (H.) & Krause (M.). Findet in *Glossina morsitans* eine zyklische Entwicklung des *Trypanosoma evansi* statt? [**Does Cyclical Development of *T. evansi* take Place in *Glossina morsitans*?**—*Arch. f. Schiffs- u. Trop.-Hyg.* 1934. June. Vol. 38. No. 6. pp. 257–259.

The authors made 5 unsuccessful attempts to infect *G. morsitans* with *T. evansi*.

Freshly hatched *G. morsitans* were fed for one or more days on guineapigs, and in one experiment on a goat, infected with *T. evansi* and thereafter on a series of healthy guineapigs. In the 5 experiments, 51, 21, 87, 308 and 280 flies were used. The conclusions reached by the authors from this work are that *T. evansi* may be transmitted mechanically by *G. morsitans*, but a cyclical development of the parasite does not take place in these flies. The first of these conclusions is apparently based on the single experiment, details of which are summarized here.

Days	1–8	51 *G. morsitans* fed on a heavily infected guineapig.
,,	9	Flies starved.
,,	10	Fed on a healthy guineapig (1st filter animal).
,,	11	Fed on a healthy guineapig (2nd filter animal).
,,	12–40	Fed on a healthy guineapig.

The flies were then all killed and dissected with negative results.

In both the "filter" animals a few trypanosomes appeared in the blood on the 19th and 23rd days, respectively. In the 1st filter animal the trypanosomes were only found once, and in the 2nd filter animal on 3 days; thereafter the blood was always negative. The third guineapig used in this experiment did not become infected nor did any of the guineapigs in any of the other 4 experiments. [It is unfortunate that no information is supplied regarding the genesis and subsequent maintenance of the strain of *T. evansi* used in this experiment. For all we are told it may be an old strain of doubtful origin which has been maintained for years in European laboratories by syringe passage. If this proves to be the case, obviously inferences drawn from work of this sort must be regarded with great suspicion. The observations recorded in the experiment outlined above, relating to the mechanical transmission of the trypanosome to guineapigs by tsetse 2 and 3 days respectively after the last feed on the infected animal, are certainly remarkable. Previous work on mechanical transmission has raised considerable doubt whether such a thing occurs apart from that due to "interrupted feeding."] *W. Y.*

Dias (Emmanuel). Estudo sobre o *Schizotrypanum cruzi*. [**Studies on *Schizotrypanum cruzi*.**]—*Mem. Inst. Oswaldo Cruz.* 1934. Feb. Vol. 28. No. 1. pp. 1–110. With 12 plates. [124 refs.]

This paper represents a revision of the life-history of *Trypanosoma cruzi* and of the method of its transmission. The work was conducted partly at the Instituto Oswaldo Cruz and partly in the Lassance province of Brazil.

It is unfortunate that the author persistently refers to the parasite as *Schizotrypanum cruzi*, in spite of the fact that this name has long ago been rejected by its creator (Chagas, 1911) and the original name,

Trypanosoma cruzi Chagas, 1909, reinstated. The latter name, which has been used in the previous publications of Dias himself, should be retained both because it is the only valid one and for the sake of uniformity in the nomenclature of the trypanosomes.

The first part of the paper is devoted to the development of *T. cruzi* in the vertebrate host. This proceeds along familiar lines, but special emphasis is given to the histotropism of this parasite. During the early periods of infection the trypanosomes first of all invade and multiply in the tissues at the site of inoculation, showing a particular predilection for the cellular elements of the reticulo-endothelium. According to Dias, *T. cruzi* is primarily a parasite of the R.E. system, only secondarily adapted to other tissues, the most important of which are the striated muscles, while some races derived from the armadillo are neurotropic. It would appear that the R.E. system plays no rôle in the defensive mechanism, since the course of infection in animals is not affected by splenectomy or by blockade.

The immunity which develops is only a relative one, the animals being subject to relapses and remaining susceptible to reinfection. The serum of recovered animals does not seem to have any of the trypanocidal, agglutination or adhesion properties found in other trypanosomiases.

The invertebrate cycle of development and transmission of *T. cruzi* were studied in laboratory-bred *Triatoma megista*, the common vector of Chagas' disease in the province of Lassance. In the main part the findings of Dias confirm the earlier observations of Brumpt, but these are now established on firmer ground by the elucidation of some obscure points which gave support to the partisans of the inoculative method of transmission. The development of *T. cruzi* normally takes place within the alimentary canal of the bug, the infective metacyclic trypanosomes being produced in the hind-gut (represented by the rectum only). It has been established experimentally that infection of the vertebrate takes place exclusively by contamination of the mucous membranes or of the intact skin with the droppings of the bug containing the infective stages of the trypanosome, or by ingestion of the bug itself (in the case of armadillo), whereas complete failure followed the numerous attempts to obtain infection through the bite of infected triatomas. The claims of the supporters of the inoculative method of infection were based on the alleged finding of trypanosome forms in the salivary glands of the bug, and on infection of animals by its bite. Dias failed to find any flagellates in the salivary glands of infected Triatoma. As regards successful inoculation through the bite, this was undoubtedly due to the survival of unaltered blood trypanosomes in the stomach of the bug: these have been observed up to 8 days after the infective feed and were shown to be capable of producing infection under experimental conditions.

The results obtained by Dias deprive Chagas' hypothesis of the inoculative method of transmission of *T. cruzi* of all grounds for further consideration and establish its position within the *T. lewisi* group without any *arrière-pensée*. The author notes that in districts where trypanosomiasis occurs the beds of the inhabitants commonly harbour triatomas and the bedding is always found to be soiled with the droppings of the bugs and with blood-spots from those insects that had been crushed after a feed. "This circumstance," the author remarks, "is of great importance in understanding the mechanism of contaminative transmission of Chagas' disease." *C. A. Hoare.*

Universidad Buenos Aires Misión de Estudios de Patología Regional Argentina Jujuy. 1934. Publicación No. 14. pp. 1–24. With 8 figs. (1 map); pp. 25–42. With 9 figs.; pp. 42–45. With 2 figs.—Investigaciones sobre la enfermedad de Chagas. I. Comprobación de formas agudas de tripanosomiasis americana en el Chaco Austral y Santafecino. [**Acute Form of Chagas's Disease in Southern el Chaco and in Santa Fé.**] II. Comprobación de formas crónicas cardiacas de tripanosomiasis americana en el Norte Santafecino. [**Chronic Forms of the Same.**] III. Nuevas investigaciones sobre animales naturalmente infectados con *Trypanosoma cruzi* en el Norte Santafecino. [**Study of Animals Naturally Infected with *T. cruzi* in Northern Santa Fe.**] [Romaña (Cecilio)].

In the first of these papers the author states that on an average 60 per cent. of *Triatoma infestans* examined in this district showed infection by *T. cruzi* and that 36 per cent. of the local armadillo, the nine-banded, (*Dasypus novemcinctus*) were carriers of it, and further that there was widespread infection of *T. geniculata* in the human dwellings. He then relates in detail two typical cases, one a boy of 8 years, the other a girl of 2½ years, with their cardiograms, X-ray pictures, blood counts, etc., and the results of inoculation of their blood into puppies. He draws no definite conclusions, but records the findings as indication for further study.

In the second, two chronic cases are recorded, aged 40 and 51 years respectively. They appear to be quite typical; a footnote mentions the death of the first suddenly (probably by syncope) six months after the last note in the text.

The third gives brief notes of the results of examination of the blood of 10 puppies in Villa Guillermina between March 22 and April 13, 1933; two were found infected; also one among six examined in Colonia Florencia. The blood of these was inoculated into rats, and, in the case of the last and one of the other two, parasites appeared in the blood 4 and 8 days respectively afterwards. *H. H. S.*

Chagas (Evandro). Infection expérimentale de l'homme par le *Trypanosoma cruzi*. [**Experimental Infection of Man with *T. cruzi*.**]—*C. R. Soc. Biol.* 1934. Vol. 115. No. 12. pp. 1339–1341. With 1 fig.

An account is given of experimental infection with *T. cruzi* of a patient suffering from untreatable malignant disease.

The patient was inoculated subcutaneously with the infected blood of a guineapig. On the second day after inoculation an inflammatory local reaction was observed. The temperature rose to 39°C. on the 7th day, and thereafter ran an intermittent course until the 28th day, after which there followed an apyrexial period of 8 days' duration, which was in turn succeeded by another pyrexial period. Trypanosomes were discovered in the blood for the first time on the 38th day, although subinoculations into guineapigs were positive on the 17th day. Trypanosomes were seen in the peripheral blood for only 5 days. No clinical manifestations of visceral involvement have been observed during the first 50 days, but observation of the case is being continued.

The serum reaction of Machado was positive as early as the 10th day, more intense by the 17th day, and strongly positive by the 26th day. Fragments of tissue—subcutaneous and muscular—were removed

from the site of inoculation on the 12th day. There was evidence of intense inflammation characterized by an abundant exudate of mononuclear cells, lymphocytes, plasma cells, and macrophages. Agglomerations of parasites were visible in the muscle fibres and in the macrophages, but the number of parasites was very small in comparison with the intensity of the inflammatory reaction. *W. Y.*

JACKSON (C. H. N.). **The Causes and Implications of Hunger in Tsetse-Flies.**—*Bull. Entom. Res.* 1933. Dec. Vol. 24. Pt. 4. pp. 443–482. With 4 figs. [20 refs.]

The author holds that Glossina has permanent homes in which it breeds and rests, and that it goes out and visits definite areas for feeding; by distinguishing the " hunger stage " of flies, much may be learnt about their biology.

The author's thesis appears to be that, in the permanent home of the fly, a low proportion of females comes to man (not because the insects are absent but because they are digesting previous meals or engaged in finding places in which to deposit larvae). The numbers of young fly are also low because, though they have emerged in the permanent home, they rapidly go away elsewhere for food. It follows that the majority of flies caught in the permanent home are mature males, most of which are not very hungry. In the feeding grounds, on the other hand, a human being catches flies which are more hungry, and the proportion of females and young flies is generally higher. The type of vegetation which is chosen as a permanent home or a feeding ground differs with different species of Glossina, but the view is expressed that this distinction may be observed in several species, among them *G. morsitans*, *swynnertoni* and *palpalis*.

To reach these conclusions the author defines four stages, of which the first is the gorged fly and the fourth the hungry fly: in addition to these, he recognizes "young flies." He has developed methods of marking a large number of flies in such a way that they may be individually recognized if they are recaptured (*ante*, p. 216). A considerable number of experiments are described. In one of them flies were caught and marked in the permanent home and their " hunger stage " noted: a considerable number were subsequently recaptured in the feeding ground, and those which had been hungrier when they were marked were recaptured earlier than those which had been less hungry. [In describing these experiments, the author gives no facts about the numbers of fly which were marked and never recovered: this information appears to be relevant, for if the proportion of recaptures in different groups was very different, one might feel less confidence in the significance of the figures.] Other evidence is given showing that, generally speaking, the interval between marking and recapturing is related to the number of " hunger stages " through which the fly has passed. If the interval is one or two days, one or two stages will generally have been passed; but if it is longer, the fly may have gone through a complete " hunger cycle." Season has a considerable effect on the duration of this cycle.

[The author has studied a very difficult problem, the detailed bionomics of a wild insect under natural conditions. Much of his material is new and interesting, and if his views are correct he has added considerably to our knowledge of the tsetse community. But the conscientious reader (and assuredly no one else will get far into this

paper) will notice a number of points which call for comment. In diagnosing the hunger stage, the author relies on twelve external characters, eight internal characters and four points of behaviour, and his description of his method of diagnosis runs to 8½ pages. One can hardly believe that it is possible to arrive at a sharp diagnosis by any method as elaborate as this, and one feels that there must be a strong personal element in the matter. Yet this diagnosis is the basis of the work, and much is built on a foundation which seems insecure. Might it not be possible to arrive at a quantitative and simpler diagnosis of the hunger stage? The later stages in the argument are frequently incapable of rigid proof, and it seems desirable that some precise experimental evidence should be accumulated. A third point which calls for comment is that the author has written three papers on this particular matter, and in each of them he has used a different nomenclature for the successive stages of hunger. These changes, like all other changes in nomenclature, are doubtless intended to make the reader's task easier.] *P. A. Buxton.*

Jackson (C. H. N.). **On an Advance of Tsetse-Fly in Central Tanganyika.**—*Trans. Roy. Entom. Soc. London.* 1933. Dec. 30. Vol. 81. Pt. 2. pp. 205–221. With 1 folding map.

In a certain part of Tanganyika, *Glossina morsitans* has apparently extended its range very greatly within recent years. The author describes the advance, and discusses its possible causes.

In a part of the Central Province of Tanganyika, it appears that *G. morsitans* has extended its range, in some place spreading about fifty miles in the last thirty years or so. The author is definitely of the opinion that this is due to actual spreading; he is clear that the country now occupied by the fly was previously entirely free, and that the phenomenon is not one of multiplication in an area which was previously thinly inhabited by this insect. His evidence is given at considerable length, and in such a matter one must accept the judgment of the man on the spot. None the less, the reader, ignorant of the locality, observes that part of the district was previously unmapped, and has apparently only recently been studied by Europeans. Is there really no possibility that small foci of fly have been scattered widely over it for centuries? The paper concludes with a discussion of the factors which may have caused this extension, and of the directions in which further spread may be anticipated. It seems clear that the determining factors are in the vegetation, influenced perhaps by occasional years of abnormally high or low rainfall. Attempts to study the phenomenon directly by liberating marked flies were inconclusive. *P. A. B.*

Harris (R. H. T. P.) & Whitnall (A. B. M.). **The Vegetable Diet Theory of** *Glossina pallidipes.*—*Onderstepoort Jl. Vet. Sci. & Animal Industry.* Pretoria. 1934. Jan. Vol. 2. No. 1. pp. 101–111.

This paper finally disposes of the fantastic assertion by A. Davidson (a layman), originally made and rashly acclaimed some two years ago in a portion of the South African Press, that *G. pallidipes* can subsist and breed upon a diet formed by the latex of certain plants, especially *Euphorbia tirucalli* and *Sarcostemma viminale*, whence it derives the trypanosomes of which it becomes a vector.

The investigations now described were carried out at the Nagana Research Station, in Zululand. Groups of ten *G. pallidipes*, caught in " Harris " traps, were placed in glass jars covered with mosquito netting and allowed to suck blood from a donkey, in order that, when the experiments commenced, all might be in the same condition as regards hunger. Controls were employed, and it is interesting to note that, out of ten flies which were given a single meal of donkey's blood, but nothing further, four (one male and three females) had lived for fifty-seven days when the experiment was stopped. In the actual test, when jars of flies were inverted over unwarmed " mats " made of *E. tirucalli* and *S. viminale* twigs, none of the insects attempted to feed. Warming the twigs over hot water caused a reaction to the extent that the flies tried to bite ; but they invariably failed to pierce the vegetable cuticle and epidermis with their proboscides, and eventually became too weak to make the attempt. Microscopic examination of the mats showed no sign of exuding latex, such as would have been seen had punctures been made, and no trace of latex was found in the guts of flies which died.

Latex was then drawn off into tubes—either formed from the caecum of an antelope, or closed with skin from a freshly killed bird—and diluted with physiological saline to prevent coagulation ; in one instance a mixture of citrated blood and latex was employed. After being starved for three days, batches of *G. pallidipes* were brought into contact with the tubes, the mixture in which had been slightly warmed. Under the influence of the temperature, the flies were induced to probe and pierce the membrane covering the warm latex. After they had done so, however, they quickly withdrew and cleaned their proboscides ; and flies which had imbibed some of the latex either expired in a few minutes, or died in from one to twelve hours, according to the amount ingested. The mixture of blood and latex had a similar effect.

The foregoing summary should suffice to establish the authors' contention that *G. pallidipes* does not attempt to feed upon latex in nature, and that " therefore any theory in regard to the trypanosome infection of tsetses being derived from plant flagellates is entirely without foundation." *E. E. Austen.*

LAMBORN (W. A.). **Medical Entomologist's Report for 1932.**—*Ann. Med. Rep. on the Health & Sanitary Condition, Nyasaland Protectorate, for Year ending 31st December, 1932.* Appendix I. pp. 54–60.

During 1932, while the area occupied by *Glossina morsitans* remained generally the same as in 1926, in the Fort Manning District the fly made one " definite southerly advance," subsequently dealt with effectively by clearing, burning and settlement. In the Namwera Fly Area where, no doubt partly owing to the abandonment of estates, encroachment continues, *G. morsitans* suddenly advanced five or six miles during the late rains.

Experiments to test the possibility of cyclical transmission of *Trypanosoma rhodesiense, T. brucei* and *T. congolense* by arthropods other than *Glossina* proved uniformly negative. Even as regards possible direct transmission by similar agents, in only two out of many trials with *T. rhodesiense* was success obtained, the subjects of experiment in these instances being three species of *Tabanus* and two of

Stomoxys. Thinking that blood-sucking but non-biting species of *Musca*, which batten on superficial lesions including punctures inflicted by other flies, may well be transmitters, the author late in the year turned his attention to these, with what result is not stated.

E. E. A.

Delpy & Bourret. Sur un cas de maladie du sommeil.—*Arch. Méd. et Pharm. Nav.* 1933. Oct.–Nov.–Dec. Vol. 123. No. 4. pp. 712–715.

Moroder (Juan). Enfermedad del sueño. Resumen de las publicaciones aparecidas en los ultimos cinco años.—*Medicina Países Cálidos*. Madrid. 1933. July, Sept. & Nov. Vol. 6. Nos. 4, 5 & 6. pp. 241–269; 337–355; 417–449. [360 refs.]

Correction.

Elshout (J. M.) & Lentjes (L. J. M.). De beri-beri epidemie op het eiland Onrust. [**Epidemic Beriberi on the Island of Onrust.**]—*Geneesk-Tijdschr. v. Nederl.-Indië.*—1933. Oct. 10. Vol. 73. No. 21. pp. 1288–1298.

It was stated erroneously in No. 7 of this *Bulletin*, p. 477, that the isle of Onrust in question is off Holland at the mouth of the Zuider Zee. It is in fact a small island a few miles from Batavia in Java, and is used as a quarantine station. *A. G. B.*

REVIEWS AND NOTICES.

FAIRBROTHER (R. W.) [M.D., M.R.C.P.]. **Handbook of Filterable Viruses.**—pp. ix+193. With 4 figs. on 3 plates & 2 text figs. 1934. London: William Heinemann (Medical Books) Ltd., 99 Great Russell Street, W.C.1. [7s. 6d.] [Review appears also in *Bulletin of Hygiene.*]

This is a perfectly simple straightforward record of the elementary facts regarding filtrable viruses. The first part of the book deals with general properties. After a brief historical introduction, there is a discussion on the nature of the filtrable viruses, a description of their cultivation and microscopy, and of the types of immunity to which they give rise. The second part deals with special diseases caused, or probably caused, by filtrable viruses. In the interests of clarity it would probably have been better if a sharper division had been made between the general properties of the filtrable viruses and the diseases to which they give rise. The author's classification, for instance, is not one of the viruses but of the virus diseases. The chapter on epidemiology and immunity would likewise have been more in place if it had come later, and had served as an introduction to the diseases caused by filtrable viruses. *G. S. Wilson.*

LEWIS'S MEDICAL AND SCIENTIFIC LIBRARY. **Second Supplement to Catalogue, 1931–1933.**—112 pp. 1934. London: Lewis's Library, 136 Gower Street, W.C.1. [2s. net; (to Subscribers 1s. net)]. [Catalogue revised to end of 1927 and Supplements 1928–30 and 1931–33, 16s. net; (to Subscribers 8s. net.)]

Since the publication of the new and revised edition of the main "Catalogue of Lewis's Medical and Scientific Lending Library" in 1928, two triennial Supplements have been issued to keep the work up-to-date. The second of these Supplements, now noticed, gives titles of over 3,000 books added to Lewis's library in the period 1931–33. It follows the same arrangement as the main Catalogue, with an "Authors and Titles" list followed by an "Index of Subjects." The subject headings in the latter indicate the wide interests served by the library, and the shifting of emphasis with change in outlook. Thus subjects such as 'Mesmerism' and 'Phrenology' drop out, while new headings appear for 'Careers,' 'Contraception,' 'Ecology,' 'Mental Tests,' 'Nudism,' 'Sterilization,' 'Town Planning,' etc. 'Psychology' is a subject that shows much development, and now has sub-headings for 'Educational,' 'Industrial,' 'Social,' and 'of the Unconscious,' in addition to those used in the main Catalogue. The classification has also been revised in places; for instance, the heading 'Emotions,' which covered books on 'laughter,' 'joy,' and 'happiness' in the 1928 Catalogue, no longer stands, books on these subjects being classed now with works on 'nightmares,' 'inhibitions' and 'neuroses' under 'Psychology.' Altogether these Supplements, with the main Catalogue of Lewis's library, provide a most useful guide to modern English books on medical and scientific subjects. *R. L. S.*

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